# IAVE

# INDUSTRIAL ARTS AND VOCATIONAL EDUCATION

all about the exciting field of instrumentation and control (see page 38)

- Special Report: The NDEA and Electronics
- The Prestige Image and Industrial Education, Conant
- How to Use Team Teaching in Industrial Arts, Bernucci and Hartdegen

January, 1961

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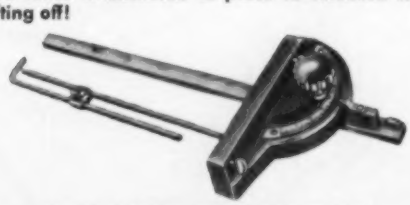

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# IA/VE

Vol. 50, No. 1 / January, 1961



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# your IA/VE for January

With this "new year's" issue, **we are very proud to announce the formation of an editorial advisory board** for your IA/VE.

As industrial education — mirroring American industry itself — becomes more complex and challenging, it is necessary, in order to continue to develop a full-dimensioned coverage of the field, **to bring to our editorial approach the views of leading industrial educators** on all levels and from major geographic regions of the country.

The following advisers have been selected with this widened and enriched editorial approach in mind. On the national level is **Marshall L. Schmitt**, specialist for industrial arts, Office of Education, Department of Health, Education, and Welfare. On the state level is **Robert L. Woodward**, consultant in industrial arts education, department of education, state of California. Representing teacher educators are **Chris H. Groneman**, head, department of industrial education, Texas A and M; **Donald Maley**, head,

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Woodward

department of industrial education, University of Maryland; and **Delmar Olson**, professor of industrial arts, Kent (Ohio) State University. On the supervisory level, **M. J. Ruley**, supervisor of industrial arts and vocational education, Tulsa, Okla., schools. Speaking for teachers are **W. J. Wilkinson**, Nether Providence Schools, Wallingford, Pa.; **John Koenig**, Midland, Mich.; and **Carl H. Hubachek**, Branford Senior High School, Branford, Conn.

In your IA/VE for January, there are several features which we believe comprise **specially choice reading items at the beginning of 1961.** These include: (1) **Dr. Conant's comments** (pg. 15) on "An Education for All American Youth" concern the false prestige image of educational values which creates a dangerous academic imbalance in our high schools; (2) **A basic document** (pg. 12) compiled by teachers on what industrial arts should be in the challenging space-age ahead; and (3) **An interview** (pg. 18) with two woodworking instructors who engaged in a pilot program of **"team teaching."**

In addition, you'll find a **half-dozen carefully selected articles on major issues and developments in industrial education,** including a **special report** (pg. 32) **on the N.D.E.A. and electronics:** what has been done and what your district can do in this area. And then there's another **profile in industry** (pg. 38) **installment (on instrumentation and control)** and **nine projects** (pg. 24 ff.).

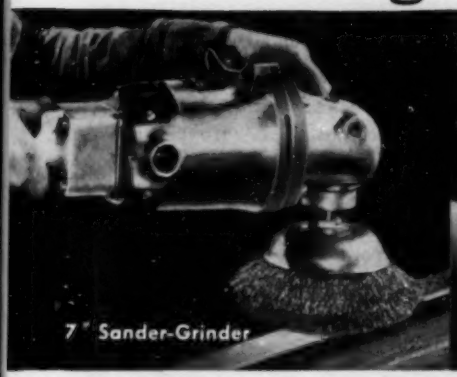
All in all, it's our way of **wishing IA/VE readers an enjoyable and successful new year!**

## in February . . .

How can the typical shop teacher make use of the benefits offered by **audio visual aids,** is the subject of this issue's **special report.** Look for information on procedures, equipment, and physical facilites.

*the editors*

# Teaching drilling, sanding, sawing,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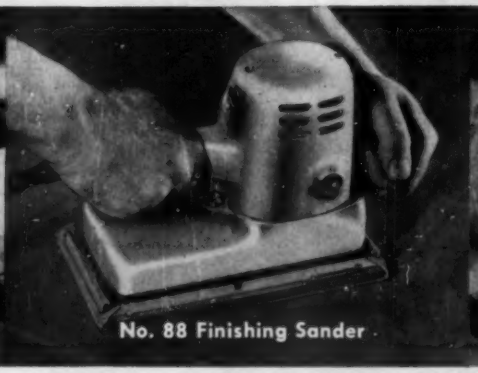
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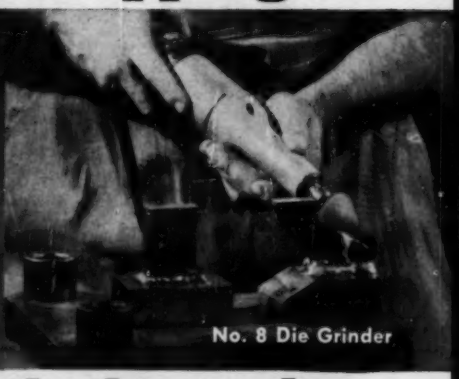
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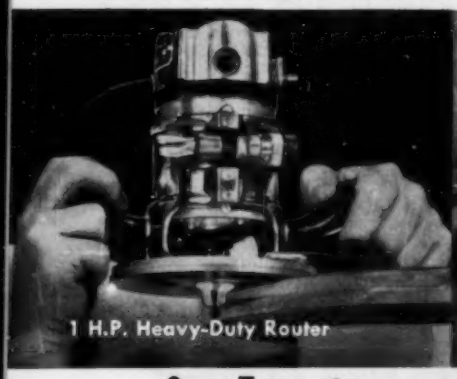
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# opinion

## SHOULD INDUSTRIAL EDUCATION TEACHERS BE REQUIRED TO HAVE INDUSTRIAL EXPERIENCE BEFORE THEY ARE ALLOWED TO TEACH?

The issue of mandatory industrial experience for industrial educators has been discussed for many years. It has been generally agreed that such experience is helpful, but should it be required seems to be the basic point.

Asked the above question about this issue, a sampling of IA/VE readers (teachers, supervisors, and teacher educators selected at random), did not believe (55 per cent) that such experience should be required.

Commenting upon negative responses, one teacher educator stated that "Anyone would be ready to admit that industrial experience would be very beneficial but I feel that, like coaching, it doesn't take a good athlete or even athletic experience to make a good or successful coach (just proper education). I still maintain the industrial training could be assimilated into the college training, possibly by omitting some (but not all) of the required social studies courses. More time could then be devoted to one's own major areas!"

**Should Industrial Education Teachers Be Required to Have Industrial Experience Before They Are Allowed to Teach?**

| Yes | 45% | No | 55% |
|---|---|---|---|

Others: "This is visionary and puts a great restriction on teachers of industrial education as compared to teachers of other subjects." "It would be helpful indeed but why handicap an industrial education teacher with more restrictions than teachers of other fields. A summer work experience program in co-operation with industrial organizations would be the best way to attain varied experience." "Experience would help, but I don't believe it is necessary in order to teach in a secondary school."

A teacher who responded negatively said that "I do not feel that this should be mandatory, but I am certain that working in industry is a very beneficial experience for future teachers. I worked seven years as a post office clerk and I feel that this experience has given me a better outlook on the teacher profession, and a better understanding of the people we are working with. All too often we get engulfed in our own particular field and forget there are other areas with problems we perhaps could aid in solving."

Of those respondents who believed industrial experience should be required, a supervisor commented that "I believe you should have practical experience in a field if you expect to teach anything about it to your students. Too many teachers are coming out without work experience, let alone industrial work experience."

Another supervisor related this area to college curriculum with the belief that "Besides having industrial experience, new teachers should be better trained on *what* to teach. Teacher's colleges are too busy teaching subject matter and forget to stress course outlines which could be used *only* as a guide giving the new teacher a chance to enrich the course according to his training. Are teacher educators today too far removed from the classroom? If so, let's make a change there and not wait until it is too late."

A teacher, in replying "yes," said that "This (training) could very easily be accomplished through summer employment or part-time employment while attending college. It would be a valuable experience and help bring a closer relationship between industrial education courses and industry." Another teacher reiterated this by saying that "This (experience) should be a part of the students' training!"


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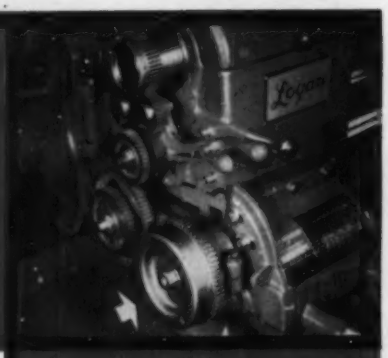

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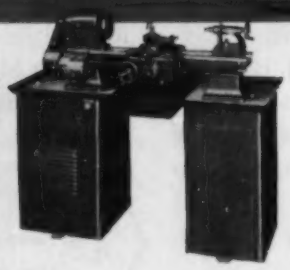

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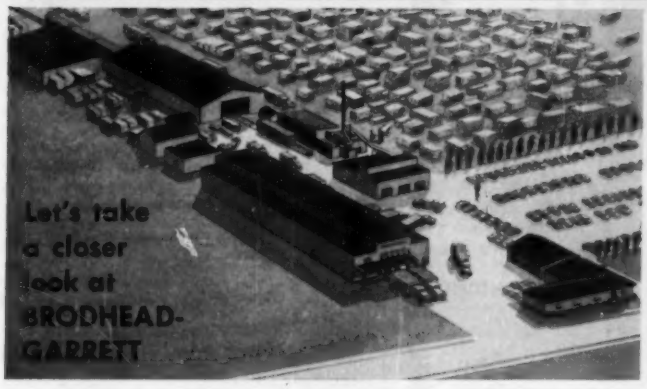

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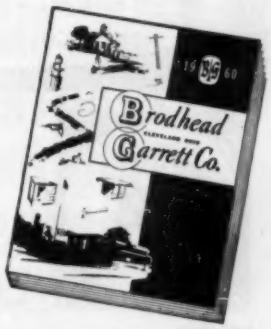


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# letters

## concerning power mechanics

I was most interested in your editorial, "The Case for Power Mechanics" (see p. 17 of your IA/VE for November, 1960). . . .

Since 1948 we have included in our junior high industrial arts program a course which we call "auto." Last year we expanded the course in this area to include other methods of transportation from bicycles through motor scooters, to rail, air, water, and eventually space. The instruction is included in a general (3-area) shop, with the other two areas being electricity and metals. The course is required for 7th and 8th graders and elective in the 9th.

**John L. Cameron**, director, department of industrial arts, Colorado Springs, Colo.

Thank you for your article, "The Case for Power Mechanics" (see p. 46 of your IA/VE for November). I have tried the course for two semesters with two different 10th grade groups and I have found it to be a shot-in-the-arm course in industrial arts. The boys really go for it.

It has its problems, but it really appeals to the boys. I would like to list some problems as I have found them in my classes:

1. The noise problem; we solved this by building a muffler box lined with rock wool insulation. A problem of advancing the speed and adjusting the gas while in the box still exists.
2. Then, too, we cannot run the engines in the classroom (fire marshal's orders). This means two or three boys are outside running their engines. This going in and out of the classroom during the period isn't too good.
3. We need a good textbook on this subject.
4. Stocking repair parts when you have the boys working on four or five popular engines is another item to contend with. Storage of engines and parts at the end of the period, too, can be a problem. Boys in another section may borrow parts needed from another engine so adequately sized lockers have to be provided.

Class sizes also enter in; 20 or 25 eager youngsters requires an instructor on roller skates.

I think the course is good, but if you have the solution to some of its problems, please inform me.

**Harry H. Bockhaus**, Mound Senior High School, Independent School District No. 277, Mound, Minn.

## for more research

Please continue to report research findings in . . . IA/VE magazine. . . . The direction you are taking in the articles is most appropriate. "Then and Now," "Teacher's Notebook," and the like are enlightening and useful.

**Donald F. Hackett**, Division Chairman, Georgia Southern College, Statesboro, Ga.



(For more information from advertisers, use the postcard on page 65)

# news

**I-A teachers** There are 32,871 industrial arts teachers in the United States, according to a survey released by John A. Jarvis, dean, school of industrial education, Stout State College, Menomonie, Wis. The report utilized estimates made by state officials.

**new I-A setup** The New York City Board of Education has reorganized the industrial arts department administration which will now consist of a director, two assistant directors, and eight supervisors. Appointments made thus far include Robert W. Cynar, Emanuel Gillers, Robin Kazer, and Arthur Weener as supervisors.

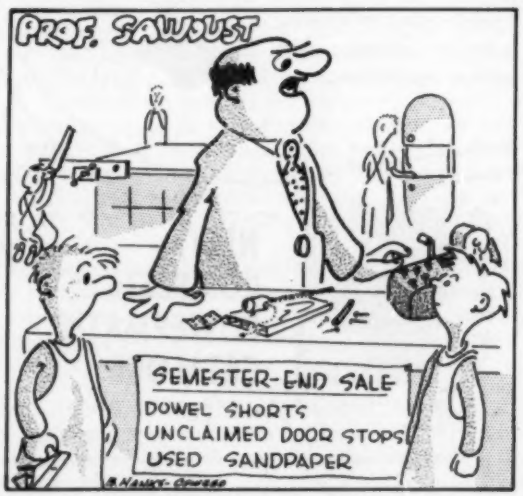
**voc-ed conference** The New York University's department of vocational education will sponsor a one-day spring conference on March 18 on "Contemporary Industrial Arts Methods." Keynote speaker will be Dr. Donald Maley, head of industrial education, University of Maryland (IA/VE editorial consultant); panel discussions will consider research, industrial art-science; mass-produced projects, etc.

**expanded programs** Trends in industrial education are indicated in the following reports of curricular expansions in local school districts: in Somerset County, N. J., vocational and technical courses in electronics, instrumentation, and apprenticeship training in such trades as carpentry, bricklaying, etc.; in Ashland, Ky., a program in electronics; in Salem County, N. J., three new two-year courses in electronics, mechanical drafting and design, and glass blowing.

(Concluded on page 46)

### SURVEYING THE SCHOOL SCENE

- Lawrence G. Derthick has resigned as Commissioner of Education to accept the position of assistant executive secretary of the National Education Association. At the same time, President-Elect John Kennedy has named Connecuticut's Gov. Abraham A. Ribicoff as the new Secretary of Health, Education, and Welfare.
- The Bureau of the Census has reported one-half the school districts today than existed in 1942 as an indication of the successful efforts of states to consolidate small school units into educationally superior, larger ones.
- A call for more genuine educational research into the strength and limitations of group tests was made by Arthur S. Adams, president of the American Council on Education who warned about the public's "blind notion" that test results are the be-all and the end-all of the educational process.
- In Washington, D. C., the school board has decided to seek legislation which would enable the administration to hold up automatic pay increases for "marginal" teachers who do less than satisfactory work.

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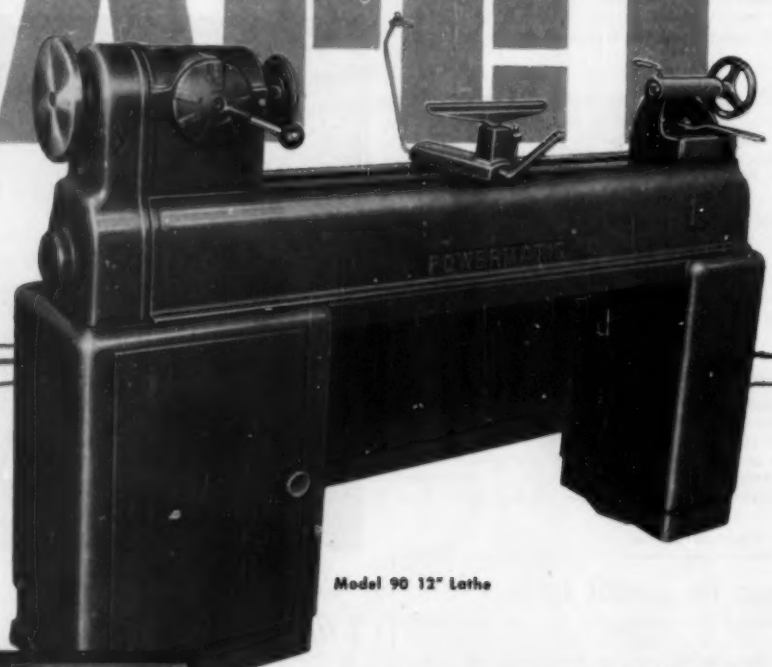


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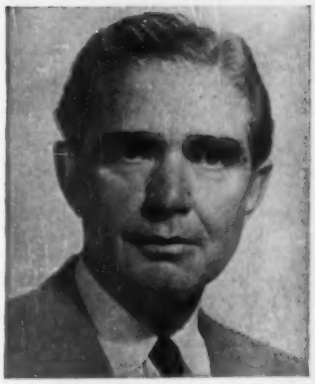
# INTERPRETING INDUSTRY, OUR WEAKEST OBJECTIVE



the editor's stand

Several recent statements have listed the interpretation of industry to youth as the number one objective for industrial arts. Is this just something we've added to our goals to satisfy parents and the administration? Exactly who are we fooling? Surely not the average industrial arts teacher. He knows that, for the present at least, he isn't doing much about interpreting industry to youth. Further, he wonders if it is possible to do the job. As of today he certainly isn't equipped for it.

Let's look at this objective critically. We hasten to add that we are not talking about the teaching of basic industrial and trade processes. Nor are we commenting on the acquaintanceship with some industrial methods that a student might acquire by working with tools and machines. Never are we considering the values that a student might receive by learning about the skilled occupations. We are discussing the objective that states "Industrial Arts interprets industry to students."

**What does it mean to "interpret industry"? Interpret is defined as "explaining the meaning of or understanding," while industry is described as "any branch of business, trade or manufacturing such as the steel industry or the automotive industry." Putting these two definitions together, we conclude that industrial arts has assigned itself the responsibility of explaining the meaning of and helping students to understand such branches of business, trade, or manufacturing as the steel industry, the automotive industry, the transportation industry, the petroleum industry, and countless others.**

Does industrial arts interpret industry? Can it interpret industry? Is it our job to give the students an insight into the operation of such diversified giants of our American industrial system as U. S. Steel, General Motors, R.C.A., or Gulf Oil? *If it is our job,* what is there about these billion-dollar industries that can be taught to teen-age youth?

All of us will readily agree that industry is highly complex and that even the experts find difficulty in completely understanding it. Generally, we think of industry in terms of research and development, production and manufacturing, sales and distribution. Industry involves such complicated subjects as management and labor, production control, time-and-motion study, procurement of supplies and equipment, inspection, and many others. Are we deluding ourselves when we say that we can interpret all of these things to our students? Perhaps we don't really mean what we're saying. Maybe we place this objective high on the list because it sounds good and because we're sure it will get a favorable reception from the people who must pay the bill.

Let's look at a few of the problems of achieving this objective. *First,* because modern industry is so infinitely complex, we are profoundly puzzled by its ramifications as applied to our job of teaching. Questions which face us are whether we should be concerned with all aspects of industry or whether we should deal only with the production and manufacture of a product. Is there any similarity between, for example, the production and refinement of oil and the manufacture of a colored TV set? *Second,* do most industrial arts teachers really know industry? What chance do most of us have to observe industry or to work in it? How many of us have had an opportunity to give serious study to its problems? *Third,* do most industrial arts teachers have the background to discuss research, development, manufacture, sale and distribution, or know what's available in our current curriculum material concerning industry? Most present textbooks give great attention to the detailed performance of basic hand and machine skills. How can these, then, be related to production? What, for example, does the learning of how to rivet two pieces of metal have to do with understanding manufacturing procedures in the automotive industry? *Fifth,* are industrial arts teachers really interested in industry? In most cases we get far more excited about what to call the first screw hole than we do about how we might interpret industry.

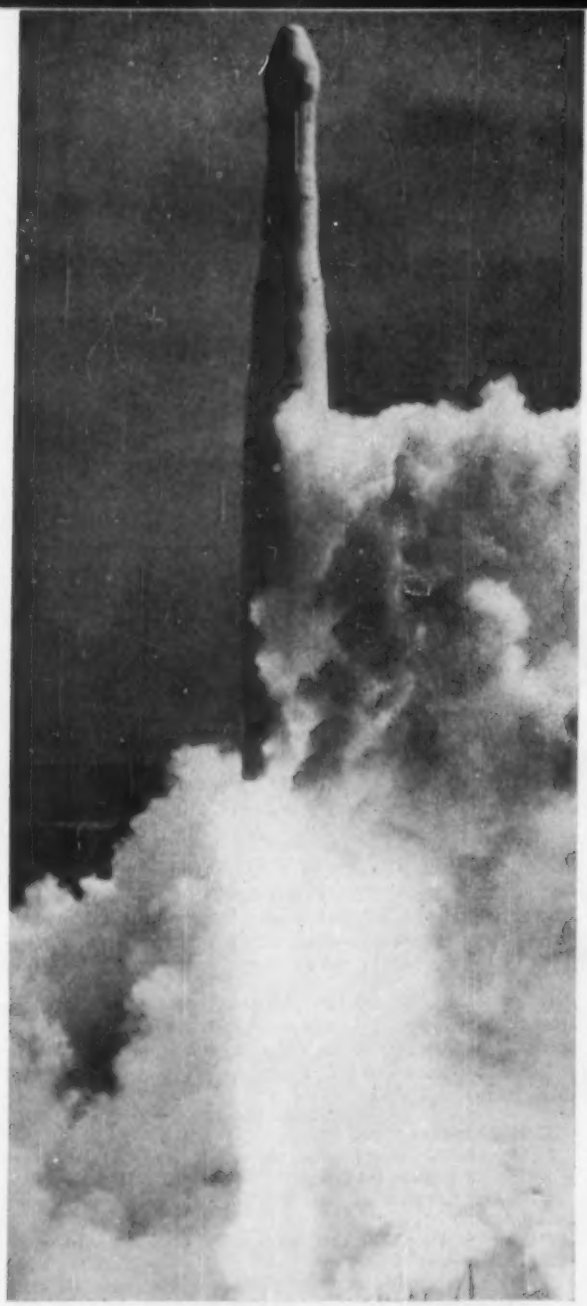
**Are we interpreting industry to youth? In the great majority of cases, the answer would have to be a flat "no." Is there any possibility of achieving this objective? The answer is "maybe," but first of all, we must discover if there are any common elements in any, some, or all industries that could be interpreted.**

If we should consider this objective, perhaps we might restrict it to the field of metalworking. In this case, what are some of the concepts or *big ideas* that could be taught? The following list is limited but it may present some of the items that can be considered:

1. The significance and importance of precision measurement.
2. The idea of mass production.
3. The concept of interchangeability of parts.
4. The significance of jigs, fixtures and holding devices in manufacturing.
5. The breakdown of complex jobs or processes into many simplified jobs or skills.
6. The importance of automatic equipment in manufacturing.
7. The procurement and handling of materials and parts during manufacture.

If these are a few of the *big ideas,* how then can we effectively teach them in the school shop? Not by producing a project by craft methods typical of a generation ago. We must think in terms of 20th-century manufacturing procedures. We must prepare the curriculum material, visual aids, and physical facilities that will provide for these experiences, and our teachers must study industry with a view to greater understanding of it. We need specific courses in teacher education which provide the future teacher with the background to handle this objective. If the profession is serious about taking on this objective, then we ought to get about the task of really doing it. If, on the other hand, this is mere educational propaganda, then perhaps we should drop it from our list and assign ourselves some more realistic objectives. ◀

*John L. Feirer*



— U. S. Air Force

# A Teachers' Declaration for Space-Age Industrial Arts

▶ **Challenged to declare their philosophy concerning industrial arts education** by such statements as "Industrial Arts: Hard or Soft Education?" (see pg. 13 of your IA/VE for February, 1960), teachers attending the 1960 summer session's Workshop in Industrial Arts at the University of Pennsylvania **forged out the following statement.**

▶ It represents **a basic blueprint** on the definition, scope, objectives, standards, individualizations, and techniques (written material, homework, use of science and mathematics, etc.) **of the field of industrial arts for the space years ahead.**

Questions raised in the past by both learned and uninformed critics of industrial arts have been answered by many, but seldom by teachers, those professionals most involved in the field. We industrial arts teachers from urban and suburban schools have undertaken to clarify the structure and universal necessity of this area.

**Definition**

To provide a common basis for this clarification, we offer the following definition:

**Industrial arts is that part of general education which provides study of the industrial and technical aspects of our economy. It involves laboratory and research experiences in the organization, tools, material, processes, and social problems of modern industry.**

**Scope**

The question has been raised: "Are there basic concepts, understandings, applications, information, skills, attitudes, and appreciations in the area of industrial arts that are good for all?" Industrial arts is an area that appeals to the interests and fulfills the needs of most students. As industrial arts teachers we want all students to share in the rich experiences which the area of industrial arts offers. Since industrial arts is a vital part of the general education of all youth, and this includes both boys and

girls, the areas of industrial arts assume a logical place among the school curricula.

If education is to be real, it must have meaning; industrial arts supplies that meaning. Additionally, it provides for the exercise of imagination and creativity — two vital ingredients for human progress. In today's complex world, no one can escape the effects of industrial activity, since it is so deep-rooted in all areas of living. Hence, education must include some idea of the scope of modern technology, if for no other reason than that today's consumer must be able to purchase and use industrial products intelligently.

Because industrial arts furnishes knowledge about modern industry, it fulfills an important guidance function by better qualifying a student to choose a career suited to his abilities, interests, and personality. This information helps him to choose a more suitable job and become better adjusted economically and socially. The areas of industrial arts have a natural relationship to all other fields of study. Industrial arts correlates all the academic studies. A good example is in the area of industrial design which utilizes concepts of psychology, art, engineering, and the physical and social sciences — to develop industrial products.

As a result of tremendous technological advances, everyone has more leisure time at his disposal. Industrial arts permits the student to sample and explore many available avenues in order to provide the best and most satisfying use of this leisure. As a discipline, industrial arts instills good work habits and safety practices. Industrial studies on the cause of labor turnover have shown that, of the people who resigned or were dismissed from their jobs, an overwhelming majority were released because of their inability to get along with others. Only a token percentage were discharged because of inadequate technical skill. Nothing is of more importance in the everyday work-world than that people learn to live and work together. Since industrial arts activities involve social relationships and their development, the student learns early to work with others.

### Objectives

Therefore, we believe the major objectives of industrial arts are:

**(1) exploration of industry, (2) development of an appreciation of good design and craftsmanship, (3) development of creative expression, (4) development of safe working habits, (5) development of skill in the use of tools and materials, (6) development of recreational and avocational interests, (7) development of consumer knowledge, (8) provide occupational information (guidance), and (9) development of healthy social relationships.**

### Standards

We believe that industrial arts education should be held to certain standards. At the end of the eighth grade, having had a minimum of two years experience in industrial arts, the student should be examined to determine his accomplishment according to the standard set for his age grade level. At this point the student should have:

1. Developed an awareness of safe behavior in the presence of shop equipment.
2. Developed a fundamental concept of the care and use of basic hand tools.
3. Acquired the ability to operate elementary power tools within the scope of his physical capacity.
4. Acquired an appreciation for the elements of good design through self-expression, considering commercial feasibility.
5. Had experiences in a variety of industrial arts areas, the industrial nature of the community predominating.
6. Know how to plan a fundamental project in all its major aspects.
7. Be able to demonstrate sufficient knowledge of a variety of industries to intelligently plan his high school activities, with consideration for his occupational future.
8. Shown evidence of growth in social compatibility and the willingness to work effectively with others.

After four years' experience in industrial arts beyond the eighth grade, the student should be examined to determine his accomplishment according to the standard set for his age-grade level. At this point the student should have:

1. Acquired well-developed safety habits in the presence of shop equipment.
2. Acquired a knowledge of the maintenance, repair and operation of advanced hand tools and power equipment.
3. Be able to produce practical designs.
4. Extended his knowledge of the industrial arts areas previously covered and increased the number of industries studied to include a maximum of community industrial offerings.
5. Be able to plan in detail an advanced or complex project in all aspects.
6. A sufficient knowledge of a variety of industries to intelligently plan his occupational future.
7. Shown evidence of growth in social compatibility and the willingness to work effectively with others.

### Individual Differences

Currently, industrial arts is offered to students preparing themselves for college, terminating their education at the end of senior high school, and possessing limited ability.

For the students preparing themselves for college, standards 3, 4, 5, and 6 should be intensified in the following aspects:

3. Problem solving and originality
4. Organization and processes of industry
5. Production methods, cost analysis and commercial feasibility
6. Field research and reporting should be extended to increase the number of industries studied.

For the terminal student, standards 2 and 3 should be intensified in the areas of manipulative skill and practical application.

For the limited ability student these standards can be modified to the extent that they challenge these students to produce to the maximum of their physical and mental capacities with consideration for their future means of earning a livelihood.

### Techniques

In striving for these standards, *certain techniques* should

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**Mr. William T. Kelly,** assistant director of vocational and industrial arts education for the Philadelphia, Pa., schools, directed this challenge to students at his University of Pennsylvania summer workshop. According to Mr. Kelly, "It is my sincere belief that too many industrial arts teachers have accepted the objectives and goals stated by recognized writers without delving deeply enough into the understandings that are basic to sincere convictions and enthusiastic zeal for their chosen area of education. I am sure that, regardles of how others may feel concerning this statment, these teachers have a deep and abiding understanding of the basic fundamentals involved in industrial arts education and will be more likely to be vocal in their promotion of this phase of education."

be followed. There is so much to be said about *teaching techniques* that volumes could be written about this one aspect alone. For our purpose we will limit our discussion to some common questions usually raised:

1. Should basic textbooks and workbooks be used?
2. Should homework and outside assignments be given?
3. Should we include applied mathematics and science?
4. How important are curriculum guides and classroom testing?

### Written Material

It is evident, then, that written material has a definite part in the industrial arts laboratory. However, no one book is comprehensive enough to include all of the material presented in any industrial arts area. Therefore, we recommend various kinds of books: project or problem books, shop manuals, reference books, magazines, and occupational books. All of these books should be in a shop library.

In most areas there is usually some book available which could be used as a text for much of the "Related and Trade" information. Use of a text at home reduces shop discussion periods and allows more time for use of equipment. Since the emphasis in industrial arts laboratory work is on manipulative activity, generally speaking, much of the "Related and Trade" information can be learned at home and applied in the shop.

### Home Work

Since industrial arts education is such a vital part of the student's general education, home work should be assigned to enrich the program. It is impossible in the time allotted to include all of the desirable information of any industrial arts curriculum; therefore, some of the theory must be studied at home. One of the weaknesses of our modern educational system is that there is little applicational transfer to everyday life. If a student does not use his mathematics, science, or any other subject in his everyday life, he soon forgets most of what he has learned, and his time has been wasted.

To develop aptitudes and thereby insure a greater transfer of training, it is essential that a student be urged to practice his industrial arts experience at home as much as possible. He should cultivate an interest in industry to the extent that he will seek out industrial information in the school and neighborhood libraries and wherever else available. Only through home work and outside assignments can this enrichment be realized.

### Application to Mathematics and Science

There are many opportunities in industrial arts education to apply mathematics and science, to make them real and meaningful.

Related mathematics should be taught by using specific problems that are taken from the everyday work of the trade. The application of plane trigonometry in the set-up of the dividing head of a milling machine, or the use of algebraic equations in determining the resistance of an electrical circuit are examples. Many other practical examples and applications may be found in every phase of industrial experience which will embody the principles of mathematics.

Industry contains many examples of the practical application of the fundamental principles of physics, general science, chemistry, and mechanics. Through the related sciences these principles can be explained by concrete problems taken from the trade which the student is studying. In this manner a student will be much better equipped to solve the varied problems that will confront him in his trade. Through the proper acquaintance of the student with the practical knowledge of scientific principles and applications, the student's imagination and creative powers may be stimulated to make contributions to his industrial field.

By making mathematics and science more meaningful, it is expected that the student's interest in these areas would be aroused, and the industrial arts program would then be the stimulating agent which carries over into all of the other educational areas.

### Curriculum Guides and Testing

The curriculum guide is the best means of attaining the standards and objectives herein set forth. When following a curriculum guide, frequent testing becomes necessary to evaluate the degree to which the goals are being achieved. Since a great deal of knowledges and understandings is to be involved in the industrial arts program, it becomes a relatively simple matter to measure these aspects objectively. Objective tests have been used in many schools for academic subjects and there is no valid reason why such tests cannot be used for the academic aspects of industrial arts. A system of final examinations will facilitate the retention of the most significant aspects of the year's work.

As industrial arts teachers with pride in our profession, we have attempted to clarify our program so that it may be understood by educators and lay people alike. We feel that all students, being future citizens of our industrial society, should have the privilege and opportunity of studying that society, and that industrial arts is the best means to this end.

Our program is one which presents a challenge to the most gifted student, provides a liberal education for the average student, yet may be adjusted to fit the needs of the slow learner. With the emergence of a highly-specialized technology, the ever-increasing need for better prepared personnel at the input level becomes mandatory if progress is to continue. The presence of the objectives stressed here, and a constant elevation of the standards proposed, with the application of the principles, techniques and controls outlined to render these objectives obtainable, should place our future youth in an advanced position to cope with the strong competitive demands of our expanding human wants and needs.


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**Frank J. Helbling,** Woodworking Teacher, Rush School, Philadelphia, Pa.

**Anni S. Weinstein,** Student, Industrial Design Major, Philadelphia Museum College of Art, Philadelphia, Pa.

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# The Prestige Image and Industrial Education

JAMES BRYANT CONANT

▶ An excerpt from the best statement of the past year on **the type of education needed for all American youth** (with implications for industrial education), reprinted at the beginning of 1961 for its insights into the dangers of **false prestige in education and a threatening academic imbalance** in the programs of our country's schools —

How much misery on the part of parents and children would be avoided if the "snob values" clinging to our educational system could be eliminated. False prestige implying a higher social status for those who have "attended" college threatens improvement long overdue in educating our boys and girls for the kind of world in which they must live and work. For several decades education beyond the high school, merely because it represents a *longer* education, has been regarded as a *better* education.

### Length of Education

To my mind, full-time education beyond the high school should be thought of not as a matter of prestige but as desirable only to the extent that it is a fruitful development of the potentialities of the student. For the scientist, doctor, lawyer and future scholar, six years beyond high school is a minimum. For other occupations, shorter periods of time are justified. And for still others, full-time education may well terminate with graduation from high school, or *even earlier*. I am not one to judge a high school unfavorably if the "drop-out" rate is high. It all depends on who drops out and what happens afterward. . . .

In part, juvenile delinquency arises from the existence of academically frustrated youth who are unemployed. There are, of course, many other factors. The purpose of this article is not to supply an answer to the complex problem of how to reduce juvenile delinquency; my intent is rather to direct the attention of all public-spirited citizens to the need for public concern for *all* American youth. . . .

### The Needs of All

No one would consider requiring all boys and girls, irrespective of their talent, to spend hours trying to play a musical instrument. Yet some recent proposals I have read about a high school curriculum seem to me equally absurd. To be sure, if the United States is to survive in the kind of world in which we live, rapid improvement of the education of the academically talented youth must take place. But in our zeal to upgrade the schooling of one group of students — the exceptionally bright boys and girls — we must not forget the needs of all the others. We must not neglect the development of the manual skills or the education of future voters.

In our desire to plan a curriculum which will provide a wide academic base for the later university education of professional men and women, we must remember that a vast majority of high-school students have no intention of becoming engineers, scientists, doctors, lawyers or university professors. Their vocations require a shorter period of formal training. If their interest in high-school work is to be maintained, they must see the relation of their studies to their plans for later life. For every teacher of experience knows that if education is to be anything more than "rote learning," the pupil's interest in the subject must first be aroused. Particularly boys and girls who have failed to enjoy success in mathematics, English and social studies in the lower grades must be motivated (the educators' word) by a realization of the connection of the high-school work with their ambitions. For this purpose some portion of the school day in the eleventh and twelfth grades should be devoted to practical courses. For girls, these may be courses in home economics, typing, stenography or the use of clerical machines; for boys, vocational courses such as auto mechanics or machine-shop work. . . .

### Fake Prestige Values

I close with an appeal to parents to be aware of false prestige values which arise by taking the length of education as a measure of its value, and an appeal to citizens to consider the entire youth problem of our cities — schools *and* employment opportunities. We should not let our proper concern for the education of the bright pupil in school and university blind us to the social consequences in a democracy of producing, even a small number of thwarted and resentful youth. In the decades ahead we need well-trained technologists and imaginative scientists, but above all we need a healthy body politic. ◀

*Excerpted from the article, "Public Concern for All American Youth," by James B. Conant. Reprinted by special permission from the May, 1960, issue of the *Ladies' Home Journal*. © 1960, The Curtis Publishing Co.

# Applying Industry to an Advanced Wood Program

WILLIAM J. WEAVER

- Do related lessons and field trips provide **students with an idea of the industrial world** of jig and fixture design, quality control, etc.?
- The author of this program doubted this and organized **furniture production using industrial methods.**

What will students face in tomorrow's industrial society? Most likely they will be confronted with designing jigs and fixtures, machines, quality control, assembly lines, finishing, inspection, and marketing. Will their understanding of these procedures be adequate to insure them confidence in seeking a position in industry?

In evaluating your own program, these and similar questions should be raised. In an effort to give the student a good, general industrial background, were related lessons and field trips enough? Is it possible for the instructor to lead industrial arts students into industry by teaching basic industrial principles, starting with the choice of a product to be manufactured until it finally reaches the consumer?

Related lessons emphasize many of these points and industrial visits stamp more impressions upon the student's mind but, as the saying goes, "experience is the best teacher." Aren't these students capable of applying the principles of industry in their own laboratory by organizing and producing a product using industrial methods?

### Industrial Methods for Advanced Woodworking

In the author's previous situation, several products had been successfully designed and produced industrially by junior high students in the industrial arts general laboratory. It was felt, moreover, that students in the advanced wood program would profit by learning methods of furniture construction using industrial methods. Previous to this each student chose to build a piece of furniture such as a dresser or a desk. Some of these were completed and some were not and in some cases the results were not satisfactory. Realizing that much time and materials had been wasted and the inability of teaching students enough about industry through the individual project caused the question, "Why not produce an item of furniture using industrial methods?"

**Mr. Weaver** is an instructor of industrial arts at New York University.

Building upon this thought, our industrial arts wood laboratory took on the appearance of a factory as the students planned and produced 20 desks of good quality. These were quickly sold to satisfied customers. The following gives the procedures from start to finish.

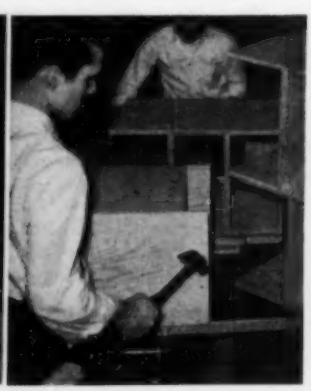
The students became acquainted with industrial arts as the study of industry from the very beginning. An explanation was given of the material to be covered for the term. They were given to understand they would choose a product which they would design, manufacture, and sell, wholesale or retail.

Two areas were covered in the advanced wood program, with 20 weeks devoted to each area. The first 20 weeks was apportioned to the study of furniture manufacturing and the second 20 weeks, the light frame building construction industry. Keep in mind at all times that industrial techniques were used throughout the course to accomplish all of this.

### Furniture Procedure

In choosing a product which would be manufactured in the first 20 weeks the boys were asked to "dream up" a piece of furniture which they might find useful in the home. The boys understood they were not obliged to purchase this furniture for themselves but could sell it at a profit. With this in mind the morale of the boys was obviously high.

Aspects of the industrial approach to an advanced wood program: drawer assembly line; fastening drawer dividers; preparing for finish; and the finished product.



### 1. Design and Drawings

After the boys voted on the product they wanted to make in the furniture line, they set out to create a good, functional design. Even before they attempted to make drawings or sketches, they were taught the fundamentals of drawing. This was satisfactorily accomplished by having them make a three-view orthographic drawing and an isometric drawing of a block of wood or some other rectangular object. On these drawings they were taught the alphabet of lines, lettering, and dimensioning. Blackboard sketches of the information wanted was very helpful.

Lessons were given on design. Form and function were stressed and the boys saw all this in reality by using mail order catalogs, newspapers, and various magazines available.

After making a working sketch using the principles outlined, the boys were prepared to make their assembly drawings. The assembly drawing of the product consisted of a three-view orthographic and an isometric drawing using the working sketches and the previous drawing for a sample.

From the assembly drawings, working drawings were made of all the parts. These drawings were given a name and part number. They were made on tracing paper, duplicated, and stapled into book form for use in the industrial arts laboratory.

The cost of materials was figured from these drawings and the factory price ascertained, which was the amount the class needed to be reimbursed. With this information in hand the boys decided upon a fair profit and then the retail price was arrived at. It was found that if there was a great demand for the product by the student body that a wholesale price should be determined so that these people might have the benefit of the manufactured product.

### 2. Prototype

The next step was to build a prototype, the working sample of the product. From the prototype, which had to be functional, any changes in the assembly drawings were made and the working drawings corrected. Once the prototype was completed and all difficulties ironed out, the boys were assigned to jig and fixture committees. At this point we visited the Kroehler Furniture Manufacturers in Binghamton, N. Y., to gather new ideas and to widen our vision. As many phases as possible of the industry visited were discussed in class to see how closely we were paralleling our objectives.

### 3. Jigs and Fixtures

Now the students saw the need for doing some real planning in making jigs and fixtures so as to save time and money and keep the profits up.

The time had arrived to determine the number of finished products that could be marketed to the public. Marketing was effected satisfactorily by designing a brochure type sales sheet with an isometric drawing showing the finished product. The drawing was coupled with the following information: dimensions, choice of finish desired, price, down payment, date, salesman, and customer's receipt.

### 4. Part Manufacture

After the jigs and fixtures were completed and samples were produced to check for accuracy, the boys were ready to cut the parts to size. A responsible student was assigned to quality control and it was his duty to keep check on the part dimensions and also see that parts would fit matrixes before they could pass inspection. The quality control engineer had assigned to him inspectors to aid in this operation. Also under the quality control engineer was assigned one student to keep inventory. It was his duty to keep count of the number of parts that had passed inspection and to category, label, and store them for future use. The inspectors had to be careful that too few or too many parts would not be produced which would create waste or halt production later. It was found beneficial to increase the number of parts manufactured by three to five per cent to offset any unforeseen contingencies on the assembly line.

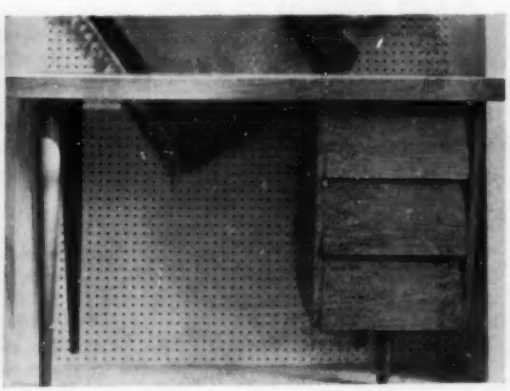
The reason for breaking down the whole factory operation into cutting parts to size and into assembly was to achieve better continuity between the students thinking and to overcome limited lab facilities and space.

### 5. Assembly

Once the number of parts were manufactured, the students were ready for setting up the assembly line. Here again democracy played a part in getting the students to achieve the most thorough group cooperation. These groups were called assembly committees which were similar to the jig and fixture committees explained previously. These committees again studied the prototype for the possibility of making jigs — this time assembly jigs — for the purpose of making subassemblies or for combining the subassemblies into the finished product.

### 6. Finishing and Sales

The products, when all assembled were made ready for finishing and this was simplified by using only three finishes, for example: blonde, mahogany, and maple. This same idea is used in industry on such things as furniture and TV cabinets and saves complicating the number of finishes used. It might be pointed out here that an additional charge might be made for custom finishes, if desired. The actual sale completed the operation. ◀



# How to Use Team Teaching in Industrial Arts

▶ Perhaps the most dramatic, new instructional pattern emerging in high schools today is **the use of the team teaching technique.** Fitting in the trends toward large-group instruction, block scheduling of classes, "time modules," etc., the teaching team concept decreases repetitive lectures to small groups, relieves teachers of routine clerical work, etc. **The question is whether this can be applied to industrial arts.**

▶ In the East Side Union High School District in San Jose, Calif., **woodworking instructors Vincent Bernucci and Max Hartdegen devised such a program** this past summer.

▶ The following report questions them on **their handling of such problems on physical setting, organizing the course, developing an altered curriculum,** etc.

▶ Provided during a summer session, **this program is an important step toward the development of fully coordinated team teaching arrangements** by the entire staffs of high school industrial arts departments.

**Q. In setting up your team teaching approach, what was the first problem you had to solve?**

A. The immediate problem was one of space. Several workbenches were added to the floor plan of the shop and enough stools provided so every student would have a seat and a place to work. Furniture was arranged to prevent congestion and interruptions of normal traffic flow within the shop. An adjoining classroom was used for more comfortable seating for discussions, films, study assignments, and student planning.

**Q. And did you also have to make an adjustment in available equipment?**

A. Yes, additional common hand tools were borrowed from other shops to provide a sufficient ratio of tools to students. Although no increase was made in the major machine woodworking tools, more portable electric tools, such as sanders and drills, were furnished. It was our desire to prevent time from being wasted because of a lack of equipment and supplies. Special tools or materials which were not in use during the summer recess were available from other shops in the district.

**Q. Organization of such a course would seem to be very vital to its effectiveness. How did you handle this?**

A. Prior to opening day, we discussed several ideas concerning how the course was to be administered. In the East Side Union High School District, the summer session courses last six weeks. Students enroll in only one course, which meets in the morning for four hours and 50 minutes. This morning session is equal to about five regular school days. Our session, then, was equal in course hours to the same course as it is given during the school year.

To accelerate class progress, we came up with several ideas to simplify class management:

1. We used colored name tags (similar to those used at convention) to learn names quickly. Beginning students wore yellow tags and advanced students were identified by white tags.

2. We also used these tags to indicate achievement in power machinery. As the student completed the required safety and operation tests on the power equipment, we stamped the tag. If a student's tag had "jointer" or "table saw" or whatever, we didn't have to check records to determine whether or not he could use the machine. You might call this tag a "walking progress chart" — and the kids wore them with the same flair as they do in industry.

3. Also we tried heterogeneous or mixed-level grouping of beginning and advanced students. By having both levels of students using the same workbenches, the beginning student was able to observe the work of the advanced student. (This also eliminated the "large-project" problem of several advanced students at one table.)

**Q. With such long periods of 290 minutes, how did you maintain student interest?**

A. This was another problem, especially since it was necessary to present a week's instruction at one time (remember that each day was equal to five regular daily periods.) Since certain times must be set aside for classroom activi-

ties, long periods of discussion or lecture had to be broken up.

We resorted, first of all, to audio-visual aids. We had ready for immediate use a 16mm. film projector, a 35mm. slide and filmstrip projector, an opaque projector, a tape recorder, etc. During an hour's presentation, we varied the lecture with two or three of these devices. A tape recording of machinery sounds, a discussion of noise, 35mm. color slides of lumber mill activities, followed by projected photographs of the subject through the opaque projector was one approach. Also, during the shop activities, some students viewed films a second time to digest finer points.

**Q. Did you find this variety to be, for the most part, effective?**

A. Yes, we did. Another emphasis which seemed to work well was the use of instructional charts which we made by photographic processes. Since we had a library of 50 textbooks and references, much visual information was available. In screening this, we concentrated on pictorial concepts which we hoped would enrich demonstrations or discussions. These were photographed, enlarged, and mounted for viewing.

In conjunction with this, we made use of definite textbook assignments. Each student had a text, class notebook, worksheets, and other instructional materials. Each student had definite requirements spelled out for them at the beginning of the session. During the course, finally, each student completed a research paper concerning some phase of woodworking: present-day practices, special techniques, job opportunities, etc.

"Both instructors must be able to work effectively together as a teaching team."

— Hartdegen

Periodic tests were given to check for individual achievement.

**Q. In your team teaching approach, what phase of adjustment from "regular" courses did you discover required most effort?**

A. Without a doubt we spent the greatest amount of time in preparing curriculum materials, lesson plans, resource units, and related topics. Dealing with a large block of time each day, spacing of instruction, variety of materials, and alternating methods of presentation had to be analyzed carefully. We agreed not to have the student engage in the same activity for more than 50 minutes, preferably 40. A typical day included two power tool demonstrations, a text assignment, a lumbering film, a presentation on design in woodworking, and an individual student activity. This varied as the course unfolded. Near the end of the course, many students were able to work at activities for longer periods of time than at the beginning.

We also utilized a 20-minute, mid-morning snack break (which became a "natural" break in the instruction sequence).

**Q. Would you tell us a little about your student personnel by way of background to your approach?**

A. Of the students enrolled in the course, 24 were beginning students entering high school for the first time. The balance of the class, the advanced students, was composed of those from high schools in the district. Some of these had already completed industrial education courses. Of this group, which was almost double regular class enrollment, several students indicated reading problems and one student was somewhat negativistic in his attitudes and was referred to the district psychologist for counseling. In general, let's say that the group represented a wide range both in age and in ability. But our primary effort in facing this large number of students was to get to know each one in the course.

"We are confident that team teaching can work in industrial arts."

— Bernucci

**Q. Now would you please tell us a little about the organization of your school day? How did you proceed with a day-to-day routine?**

A. Well, the day started at eight o'clock. One instructor checked attendance while the other made general announcements.

We'd start off with a quick review of the previous day's activities. If a student had tackled an unusual problem, it was discussed with the class. Then the group was split. The beginning students would go to the classroom for instruction; the advanced group would stay in the shop for a demonstration of an advanced operation.

By a prearranged time module, we'd know when to wind up the instruction.

**Q. Give us an illustration of typical procedures in the classroom and shop.**

A. We don't know how typical this is, but on one morning the beginning students viewed a film, discussed design projects on a screen, discussed the use of hand tools demonstrated in the classroom, and took a test. While this was going on, the advanced group watched a step-by-step procedure of cove cutting. Then there was a setup on another power tool, such as cutting molding with the portable electric router. We planned these demonstrations so that the students were seeing a specific operation which would probably be actually performed by one of them during the same day.

## flexibility in team teaching

In teaching as a team, two instructors are able to adjust their time flexibly in assisting students, both concentrating on one problem or moving about individually during the activity period.

**Q. When the class "reunited," what activity was pursued?**

A. After 40 minutes, both groups started individual project work. Both instructors moved about the class, helping and advising students. In the case of difficult problems, both instructors would concentrate on one student. And with our heterogeneous grouping, students would help each other. By having two instructors moving about, we might add, it was rare when both were so engaged that the proverbial "shop teacher's eye" didn't survey the entire class.

**Q. Permit a diversion here and describe your approach to project work.**

A. The shop activities of the students were centered around projects wholly designed by each student. Beginners experienced successful work on individually designed bowls and trays, and later simple furniture. Advanced students immediately concerned themselves with more complex problems, also originally designed.

The range of completed projects included primitive masks, water skis, mosaic coffee tables, etc. We tried to achieve a healthy, permissive attitude by which the students had the freedom to conduct research on their projects and work independently at their own speeds and, at the same time, complete the other course requirements. We tried to correlate this activity with individual student ability; but we believe that, because the students operated within a framework which left much of the responsibility on their shoulders, more in the way of learning in using tools and materials, in related information, and in specific resource unit was accomplished. (At times it seemed that the work output of 44 students during the class session was staggering!)

**Q. Let's return to your class routine. What happened after the project period?**

A. Well, the students had a 20-minute snack break while we set the scene for the rest of the morning's activities. We presented a unit to both groups with filmstrips and charts and discussion. Following this instructional unit, tests or quizzes would be given to the group, followed by the assignments for the next day. We followed this with the second shop project period which lasted until the clean-up period started.

**Q. In summary, what factors do you attribute to the facility of your team teaching approach?**

A. That's a little difficult to evaluate. Whatever success we attribute to the fact that individually we complemented each other's previous teaching experience. We had to be able to plan an effective unit and to contribute a share in order to make the individual unit a success. We had to define our goals clearly, master our subject matter, and polish our teaching techniques. Each must contribute in a "team approach" to make the course functional.

**Q. In your opinion, what is the future of team teaching in industrial education?**

A. We believe enthusiastically that there is a bright future for team teaching in individual arts.

Countless modifications are available in scheduling this type of instruction. Already we have a schedule modification where courses can be presented in an altogether different fashion than is possible in the conventional 55-minute day.

In districts across the country, schools are being designed and constructed so that classrooms have removable partitions. Large scale seating patterns are available with built-in a-v aids. Teachers are being relieved of nonteaching routine duties in this approach so that they can spend more time on curriculum preparation and course development.

Our pilot program proved that two instructors working together with clearly defined goals can teach effectively. More importantly, it proved that the students' individual differences can be met when two instructors working together permit them to work to their ability.

**Q. In closing, what difficulties confront other teachers who may wish to adapt this approach in their courses?**

A. They must certainly consider space, time-tabling of courses, rearrangement of curriculum sequence, and how to use all audio-visual aids effectively. In fact, it is these areas which must be explored and researched further. Answer these questions: Will future industrial arts shops and laboratories be designed for team teaching and large group instruction? Can this type of program take place successfully during the regular school year? We need more pilot programs and observations of current practices in team teaching in other areas of the curriculum!

# Resource Material for Power Mechanics

▶ The third part of a series of five articles on an **important, new instructional area** (look for next month's installment on equipment and supplies) —

**CHARLES G. RISHER**

The resource materials available for power mechanics may be subdivided under various headings. At this time, only four of these classifications will be discussed: books, films, booklets and charts, and visual aids.

### Books

The books listed by no means represent either a complete list of power mechanics resource books, nor do they represent the titles which should be found on the power mechanics teachers' "five-foot bookshelf." They do represent a list of titles the author has found quite useful in developing his power mechanics course. This list also represents titles which one would expect to find in municipal and educational libraries. A studied attempt has been made to avoid listing very old publications, even though many of the very old books relating to power contain more detailed and complete information about wind, water, and steam power applications than is to be found in recently published books. The titles of recent dates were also selected because they would be available from publishers for approval, or from larger libraries on an inter-library loan basis for purposes of study or research.

### Film

The listing of films includes only motion picture films; no slide films have been included. Those films may be secured from the distributors indicated, and may me either rented or obtained rent free on a one-way postage basis. The conditions for film use may be obtained from the distributors, or from the nearest educational film library. Because the comprehensive power mechanics course will cut across several areas of science, mathematics, and guidance, it is suggested the power mechanics teacher confer with his administrators to investigate the possibility of purchasing films in those areas which relate to power mechanics under the provisions of the National Defense Education Act.

### Booklets and Charts

The lists of booklets and charts are those which have been found to be very useful, and easily comprehended by students. When requesting these materials, all of which have been free in the past, one thing should be remembered. The manufacturers who make these materials available will consider requests for reasonable numbers, but an overwhelming number of requests for unreasonable numbers could easily and quickly shut off the supply. It is usually satisfactory to place the booklets in the school or industrial arts library, and have them used as any other book on limited reserve. The small amount of expense involved in securing the booklets should in no way decrease or diminish their value as a supplementary information source.

The charts listed are suitable for bulletin board or wall display. Some of the charts are also available in 8½ by 11 in. size for student use in notebooks.

**Dr. Risher is an assistant professor of industrial education at Western Michigan University, Kalamazoo.**

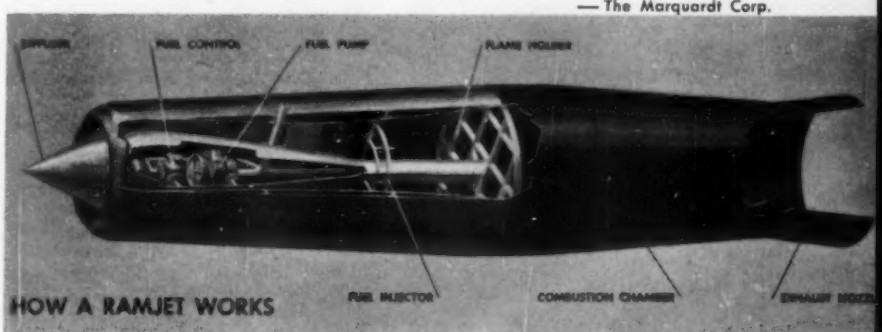
### Visual Aids

No list of cut-aways has been given because the cost of these items is such that few high schools could afford the capital outlay. We questioned the cost of a cut-away engine, and learned the major cost in such an engine is the labor cost involved in removing the unwanted parts and sections. One manufacturer of small gasoline engines stated quite frankly, "We can give away an engine to be cut up more economically than we can make the cut-away and donate it." It doesn't follow that engine manufacturers will readily give engines away, but contacting them on school letterhead will usually result in favorable conditions for obtaining an engine for educational purposes.

Relatively inexpensive cut-away visual aids can be made by securing obsolete and inoperative engines and parts from local "fix-it" shops. Allow the student to disassemble these items and to plan and make the demonstration cut-away items. It might be enlightening to observe how many metalworking processes are included in such an undertaking.

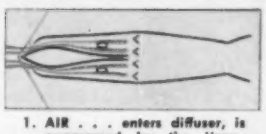
Of all the resource items which might be utilized in a power mechanics course, the most important item defies listing, categorizing, or sectioning. This most important item is the active and flexible imagination of a teacher who is willing to depart from time-honored

— The Marquardt Corp.



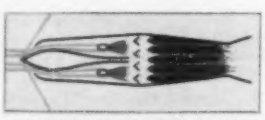

**HOW A RAMJET WORKS**

**No moving parts contact the burning gases. No complex compressors or turbines are required. Rocket assist, gravity drop or other means bring the ramjet to the required forward speed . . . the engine then operates in these simple steps.**

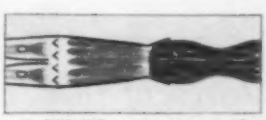


**1. AIR . . . enters diffuser, is compressed by the "ramming" action of the high forward speed.**

**2. FUEL . . . automatically controlled, is pumped through injectors and mixes with air as it passes downstream to the flame holder.**



**3. BURNING . . . starts at the flame holder. High temperature greatly expands the burning gases.**



**4. EXHAUST . . . gases expand through exit nozzle and are accelerated to several time flight velocity.**

**5. THRUST . . . results from tremendous increase in air's velocity between intake and exhaust. Pressure exerted on engine's internal structure pushes entire ramjet and its airframe forward.**

education ruts, and take an imaginative and progressive path to lead his students to an understanding and appreciation of the economic and cultural significance held by power in its various forms and widespread applications.

### Books Relating to Power From Gasoline Engines


Dake, R. H., *Aircraft Engines* (New York: The Macmillan Company, 1948).

Dyke, A. L., *Automobile and Gasoline Engine Encyclopedia* (Chicago: Goodheart-Wilcox Company, 1950).

Heldt, P. M., *High Speed Combustion Engines* (Philadelphia: Chilton Company, 1956).

Johnson, W. H., and Newkirk, L. V., *Transportation and Power* (New York: The Macmillan Company, 1949).

Northrop Aeronautical Institute, *Aircraft Power Plants* (New York: McGraw-Hill Book Company, 1955).

Neville, Leslie E., *Jet Propulsion Progress* (New York: McGraw-Hill Book Company, 1948).

Purvis, Jud, *All About Small Gas Engines* (Chicago: Goodheart-Wilcox Company, 1960).

Sawyer, R. T., *The Modern Gas Turbine* (New York: Prentice-Hall, Inc., 1945).

Venk, Ernest, *The Complete Outboard Boating Manual* (Chicago: American Technical Society, 1958).

Venk. E., Frazee, I., and Landon, W., *Outboard Motors* (Chicago: American Technical Society, 1953).

Zucrow. M. J., *Jet Propulsion and Gas Turbines* (New York: John Wiley and Sons, Inc., 1948).


### Books Relating to Power From Diesel Engines


Adams, O. L., *Diesel Operation and Maintenance*, Prentice-Hall, Inc., 1946.

Brown, T. G., and Ziegenhagen, F. W., *Elementary Principles of Diesel-Engine Construction* (Milwaukee: The Bruce Publishing Company, 1944).

Kates, Edgar J., *Diesel and High Compression Gas Engines — Fundamentals* (Chicago: American Technical Society, 1954).

Richards, E. L., *Diesel Engines and Diesel Electric Power* (Chicago: F. J. Drake and Co., 1943).


### Books Relating to Power From Steam Engines


Clymer, Floyd, *Steam Car Scrapbook* (Los Angeles, Calif.: Floyd Clymer Publication, 1945).

Dickinson, H. W., *James Watt and the Steam Engine* (Oxford: Clarendon Press, 1927).

Hart, I. B., *James Watt and the History of Steam Power* (New York: H. Schuman, 1949).


### Books Relating to Power From Nuclear Reactions


Crary, R. W., *et al.*, *The Challenge of Atomic Energy* (New York: Columbia University, 1948).

Crowther, J. G., *Nuclear Energy in Industry* (New York: Pitman Publishing Corp., 1956).

Haber, Heinz, *Our Friend the Atom* (New York: Simon and Schuster, 1956).

Hughes, D. J., *The Neutron Story* (Columbus, Ohio: Wesleyan University Press, Inc., 1959).

Kaempffert, W. B., *The Many Uses of the Atom* (New York: Foreign Policy Association, 1956).

Pearl, Carleton, *The Tenth Wonder — Atomic Energy* (New York: Little, Brown, and Company, 1956).

Romer, Alfred, *The Restless Atom* (Columbus, Ohio: Wesleyan University Press, Inc., 1960).

Smith, E. S. C., *et al.*, *Applied Atomic Power* (New York: Prentice-Hall, Inc., 1946).


### Books Relating to Power For Rockets and Missiles


Caidin, Martin, *Rockets and Missiles Past and Present* (New York: McBride Co., 1955).

Prath, Fletcher, *All About Rockets and Jets* (New York: Random House, Inc., 1958).

William, Beryl, and Apstein, Samuel, *The Rocket Pioneers on the Road to Space* (New York: Julian Messner, Inc., 1958), rev. ed.


### Books Relating to Power Mechanics in General


Aviation and Education Research Committee, *Demonstrations and Laboratory Experiences in the Science of Aeronautics* (New York: McGraw-Hill Book Co., 1945).

Branley, F. M., *Experiments in the Principles of Space Travel* (New York: Thomas P. Crowell Co., 1955).

Burlingame, Roger, *Machines That Built America* (New York: The New American Library of World Literature, Inc., 1955).

Clower, J. I., *Lubricants and Lubrication* (New York: McGraw-Hill Book Company, 1939).

Cornetet, Wendell H., and Fox, Daniel W. *Applied Fundamentals of Mechanics* (Bloomington, Ill.: McKnight and McKnight, 1944).

de Camp, L. Sprague, *Engines* (New York: Golden Press, Inc., 1959).

Fraas, A. P., *Combustion Engines* (New York: McGraw-Hill Book Co., 1948).

Groneman, C. H., Feirer, J. L., and Spry, J. C., *General Shop* (Toronto: McGraw-Hill Company of Canada, Limited, 1956).

Ley, Willy, *Engineers Dreams* (New York: The Viking Press, 1954).

Pound, Arthur, *The Turning Wheel* (New York: Doubleday, Doran and Company, 1934).

Van Loon, H. W., *Ships and How They Sailed the Seven Seas* (New York: Simon and Schuster, 1935).


### Manuals Relating to Small Gasoline Engine Operation


——— *General Theories of Operation* (Milwaukee, Wis.: Briggs and Stratton Corporation) (n.d.).

——— *Johnson Service Manual* (Waukegan, Ill.: Johnson Motors) (n.d.).

Packer, C. E., *Small Gasoline Engines* (Chicago: Popular Mechanics Company, 1957).

——— *Small Engines Service Manual*, 4th ed. (Kansas City, Mo.: Technical Publications, Inc.) (n.d.).

——— *When Your Power Mower Conks Out* (New York: Popular Science Publishing Co., 1959).


### Films Relating to Power Mechanics

**General Electric Company**

This Is Automation

**McGraw Text Film Department**

Action and Reaction
Air Age
Air in Motion
Airplanes and How They Fly
An Introduction to Jet Engines
Atomic Timetable
Automation
Automobiles
Carnot Cycle (Kelvin Temperature Scale)
Diesel Engine (Ideal Diesel Cycle)
Electromagnets
Eli Whitney Invents the Cotton Gin
Gasoline Engine (Otto Cycle)
How We Get Our Power
Inclined Plane, Wedge and Screw
Machines Do Work
Magnetism
Magnets
Principle of the Generator
Principles of Nuclear Fission
The Discovery of Radium
The First Flight of the Wright Brothers
The Flow of Electricity
The Lever
The Steam Engine
The Steam Turbine
Transmission of Rotary Motion
Wheel and Axle and Pulley

**Shell Oil Company**

Automization
Birth of an Oil Field
Crude Oil Distillation
Harnessing Liquids
History of the Helicopter
How an Airplane Flies
Lever-Age
Prospecting for Petroleum
Refining Oil for Energy
The Diesel Story

**Willard Storage Battery Company**

The Story of the Modern Storage Battery

### Booklets and Charts Relating to Power Mechanics

**American Petroleum Institute**

The Chemistry of Petroleum BO (Book)
Transportation Since 1775 CH (Chart)

**General Motors Corporation**

ABC's of Hand Tools BO
Automobile Ignition System CH
Automobile Fuel System CH
Diesel — The Modern Power BO
Electricity and Wheels BO
Four Stroke Cycle and Flame Travel CH
How the Wheels Revolve BO
Power Goes to Work BO
Power Primer BO
The Story of Power BO
Transportation Progress BO

**Delco-Remy Division (General Motors)**

20,000 Volts Under the Hood BO

**National Carbon Co.**

Automobile Fuel System CH
Engine Cooling System CH
Hydraulic Brake System CH

**Chrysler Corporation**

The Story of the Carburetor BO
The Story of Combustion BO
The Inside Story of Engine Oiling BO

DESIGN for the TEACHER

▶ The eighth in a series of articles on how to apply **principles of good design** to I-A instructional areas —

**john r. lindbeck**

Associate Professor of Industrial Education, Western Michigan University, Kalamazoo, Mich.

# Designing for the Machine Shop

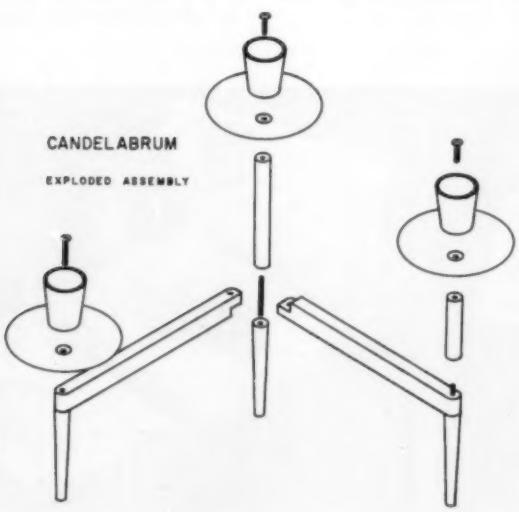
A very important part of the metalworking field, machine shop work, provides innumerable possibilities for good project design. Such skills as turning, boring, drilling, reaming, thread-cutting, facing, and taper-turning, can, with some imagination, be applied and taught through a series of sensitive projects.

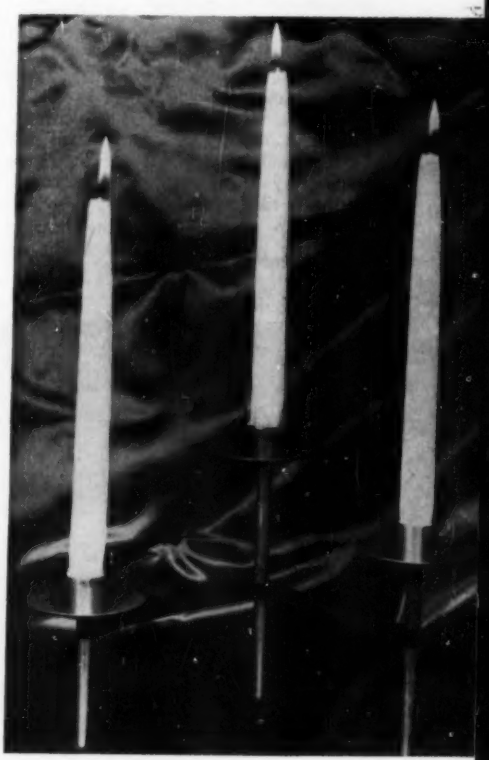
One such project is the metal candelabrum, a project which provides many stimulating machine metalworking activities. The task is approached analytically; the problem is to design a candelabrum, using metal as the material, which will meet certain specific needs. The project should adequately support candles; it should be planned in such a manner as to prevent the spilling of melted wax; it should be sensitively conceived to provide a graceful centerpiece for the living or dining room.

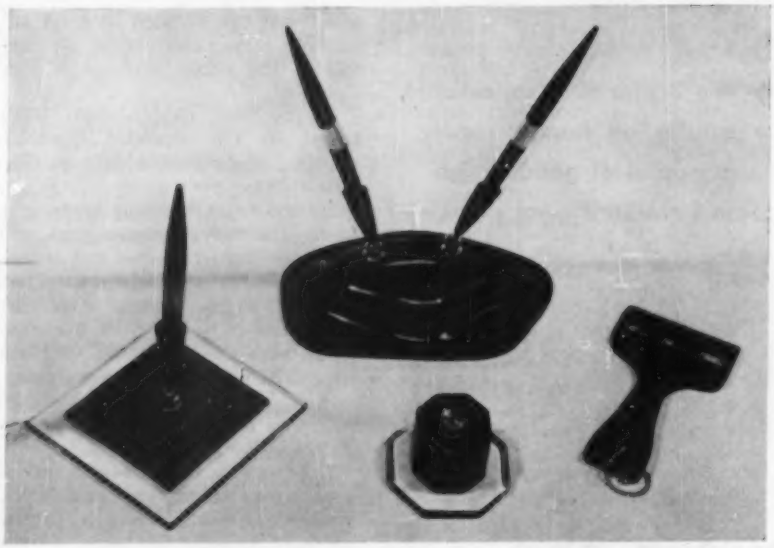
Next comes a consideration of materials to be used. Metal has been specified, but what kind of metal? Brass, aluminum, and copper, the common nonferrous metals found in the shop, can produce results both rich and interesting. Their utilization should be considered. Along with this, one must think of the processes available in machine shop work; the metal can be turned, shaped, drilled, and spun. One must never rule out a combination of materials; wood and metal can be used to great advantage, but metal should be considered the prime material in this instance.

A resultant candelabrum, illustrated in the exploded isometric drawing, was designed in brass. The stem pieces were made of ⅜ in. brass rod, with the legs tapered to ¼ in. The drip cups were spun, and the candle holders turned and drilled. These holders could also have been produced in spun brass. The bars were made of ¼ by ½ in. brass bar stock, with the offsets milled. Holes were drilled and tapped where necessary. Ebony and brass were combined to produce the candelabrum in the photograph.

A project such as this has several applications to machine shop work. It could be a class-designed project set up on a production basis; it could be given to an individual as a job assignment; or it could be given as a design problem to a member or several members of a class. These projects require that many skills be taught and learned. They further require that a certain knowledge of materials and processes be required, along with the ability to plan, read blueprints, and follow directions. However used, it should be remembered that students can profit greatly from a creative design experience, and should be afforded every opportunity to exercise their creative talents.





# FOUR POPULAR PLASTICS PROJECTS

**GERALD L. STEELE**

Chairman, Industrial Arts Department
Orono Public School, Long Lake, Minn.

The four plastics projects, which have been very popular, represent most of the operations which should be taught in beginning plastics. A high degree of skill in plastics work can be attained through these projects.

### Windshield Ice Scraper

Here is a starter project for plastics and one students will all be proud to take home. It can be made for 15 cents from scrap or reclaimed plastic. Add a key chain for 3 cents and 3 chrome initials at 7 cents each and it will still come to only 39 cents. (Sure they give them away downtown, but not personalized ones like this.)

Develop a pattern from the drawing and draw it full size. Duplicate it on ditto or mimeograph. Give each student a copy and have him glue it to a piece of ¼-in. acrylic plastic (Lucite or Plexiglas) with rubber cement. Cut it to shape, file the edges and sand to a very smooth surface. File the bevel on the edge and sand it smooth. Finish sanding the edges with very fine (320 or finer) wet-or-dry sandpaper with water. Buff to a high luster. Drill a hole in the handle for a key chain and bevel the edge of the hole with a countersink bit. Add initial letters if wanted.

### Square Penholder

Any one of your students will be proud to have this penholder in his room. Cost is about 85 cents, using reclaimed plastic, including the pen and holder.

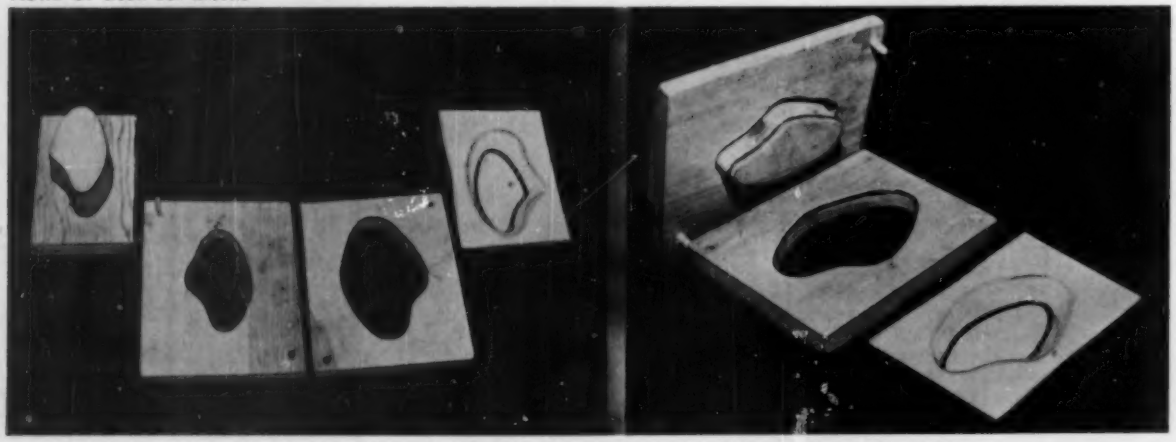
Cut the two squares of plastic as shown in the drawing. It is well if the lower one is ¼ in. clear and the top one ⅛ or 3/16 in. colored plastic. File, sand, and buff the edges to a high luster. Laminate the two pieces together with plastic cement or clear laminating dye (fast type). Center them well. Find the center and drill a hole for the penholder swivel. Countersink the hole on the bottom for the bolt head. Buff lightly to remove any scratches. Attach a pen or pencil as desired.

### Table Lighter

Many students will work overtime to make this lighter project. It can be made for less than 50 cents including a 25 cent lighter unit.

Laminate a stack of plastic squares together to form a block 1¼ in. deep. Quick drying laminating dyes of several colors may be used. Use a light colored dye on top and bottom and the darker colors in the center. After they are dry, cut the block to any desired shape. A disk or belt sander may be a great help. File, sand, and buff to a good finish. Cut a base to shape, file, sand, and buff it. Laminate the base and body together.

**Views of desk set molds**



Drill a hole to fit the lighter. Buff to a high luster.

**Formed Desk Set**

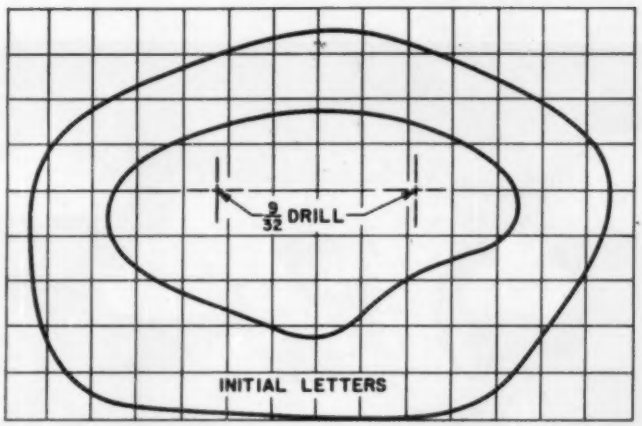
Here is an advanced plastic project which many junior high schoolers will enjoy. The cost range is from 95 cents to $2.35 with three pen sets and three chrome initials. Several shapes and designs are possible for the plastic. Here is a chance for the student to get design training. Have him design an outer shape which will compliment the inner shape that you make on the mold. (Do not expect him, however, to build the mold; you must do that.)

Make the mold from ¾-in. clear birch or hard maple. Cut the shape of the top half of the mold twice the thickness of the plastic (usually ½ in.) smaller than the inner shape of the bottom half of the mold. Save the pieces cut from both parts. Glue these cutout pieces together and cut them down to the size of the smaller of the two. Sand all edges and surfaces smooth. Glue them to a piece of plywood about 6 in. square. Round off the top corners of this center "plug." Sand the top and bottom halves of the mold smooth. Round off all edges. Drill four holes for clamping bolts. Space them so it can be put together only one way. Keep the bolts near the corners. Use wing nuts or lever nuts to clamp the mold together.

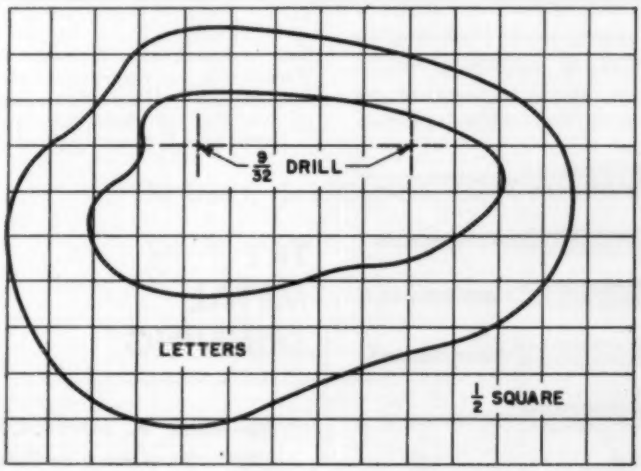
Cut a piece of plastic 5 by 7 in. in size and place it in an oven (about 225–275° F.) to heat. Allow it to get quite soft but do not let it bubble. Clamp the hot plastic between the top and bottom halves of the mold. Push the plug into the hole in the mold. Hold it in place until the plastic hardens.

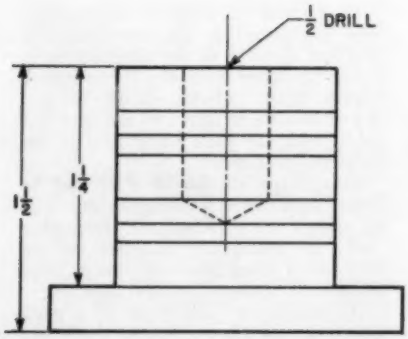
Remove the formed plastic and cut out a suitable outside shape. File and sand the edges. Buff them to a high luster.

Install pens, pencils, and/or initials as wanted to complete the project. ◀

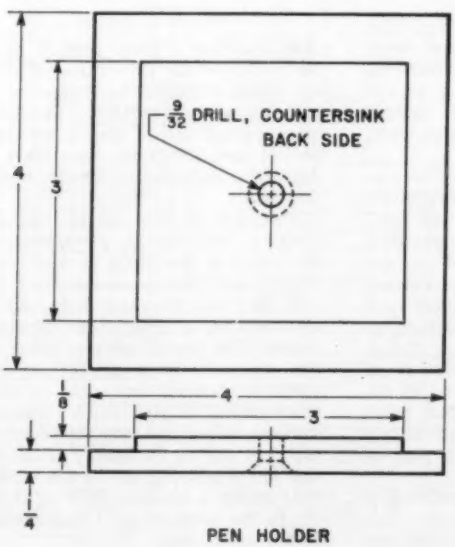



2 PEN HOLDER BASE PATTERNS

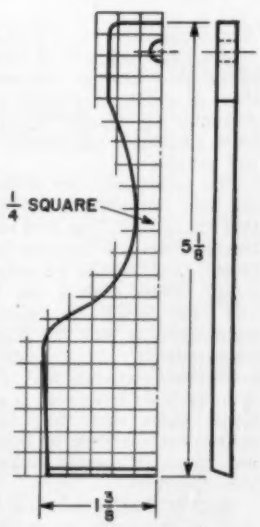


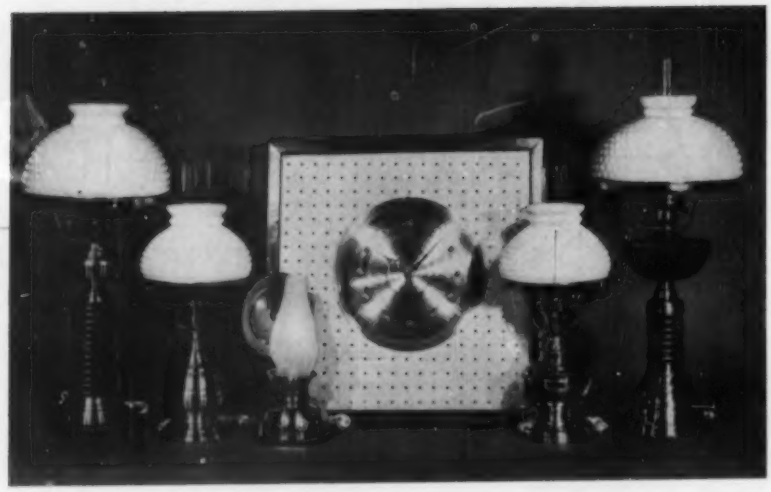

LIGHTER



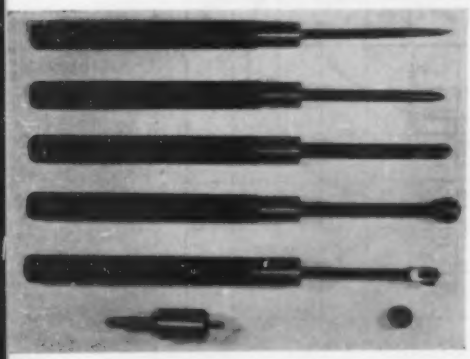

PEN HOLDER




ICE SCRAPER



Above: spun projects, illustrating the possibilities of combining various materials. Below: a view of the various tools required for spinning.



# TRY METAL SPINNING

**HAROLD V. JOHNSON**
Instructor of Machine Shop
Canton, Ill., Senior High School

Metal spinning, one of the most fascinating activities in the metalworking shop, provides the student with the opportunity to create beautiful designs from copper, brass, pewter, aluminum, and gar-alloy.

The opportunity for students to create their own designs and spin projects that are not only beautiful but also practical is unlimited. Students can get ideas from spun articles displayed in our stores. These designs can be imitated and some designs can be changed, and embellished to suit the imagination of the students.

Student planning and designing of spun projects have such a great educational value that they indeed merit serious consideration by instructors who are fortunate enough make it part of their program.

A great deal of spinning can be done with a minimum of equipment. One spinning lathe in a school shop can provide work for a great number of students. One of the advantages of providing metal spinning for industrial arts students is the fact that it doesn't require a great deal of time to produce a project and, therefore, gives more students the opportunity to do work in this field.

Beautiful projects can be created by using a combination of materials as illustrated in the lamps in which wood, copper, and brass were combined. Projects such as these are attractive and also contain a great deal of student appeal. The combination of these various materials in a project serves to create a contrast that adds to the attractiveness of the article. Plastic in various colors can also be used with metal to add to the beauty of the project. Metal spinning can be used to motivate students who take little or no interest in the usual projects that are made in the metal shop.

## Needed Equipment

Most school shops have wood turning lathes that can be used as spinning lathes. These lathes should have headstock bearings sufficiently heavy to withstand the pressure exerted upon them by the spinning tool. Lathes that are expressly made for metal spinning can be purchased from reliable manufacturers.

Spinning tools, centers, and spinning rests can easily be made in the school shop. Directions for making these tools can be found in books on metal spinning.

For spinning aluminum a hardwood stick such as a pick handle can be used. The end of the handle should be shaped like a tongue tool and will do a better job of spinning aluminum than a metal tool. A metal tool has a tendency to scratch the work.

Chucks can be made from hardwood. Maple, walnut, or cherry woods will make satisfactory chucks.

Small faceplates can be made in the school machine shop. It is a good idea to have enough of these faceplates so that they can be attached to each chuck and left there permanently.

Spinning rest and fulcrum pins can easily be made in the school shop.

The minimum amount of tools and equipment necessary to start a course in metal spinning in the industrial arts program include: a spinning or wood lathe, a flat back or tongue tool for soft metals, a point tool 5/8 in. dia. used for small work with curves, and corners, a trimming tool, 5/8 in. square, designed for trimming and turning, a hardwood backstick, a spinning center, and a "T" rest with two fulcrum pins.

Spinning lubricant to be used on the metal being spun, may be purchased in stick form. Tallow or yellow laundry soap can be used.

Students should be started on aluminum disks of 20 or 18 ga. of various diameters as the metal is much easier to spin than copper or brass. Aluminum work hardens very little.

As the student becomes proficient in spinning, brass and copper can be used in making projects. Most school shops have a furnace or forge where copper and brass can be annealed when the metalwork hardens.

## Public Relations Value

After metal spinning has successfully been established in the industrial arts program, displays of the students work should be placed on exhibit in the school display cases. Projects should be displayed in store windows to acquaint the public with the work being done in the industrial arts classes.

Great care should be exercised in arranging a metal spinning display. Use an artistic background, and remember that a few beautifully made articles, are very much more effective than a large number of projects crowded together.

An exhibit of this type is a good advertisement for the school shops and must be planned with a great deal of care so that it will bring favorable comments and the right kind of publicity.

# SYSTEMATIC AUTO MECHANICS CHECK CHART

**EDWARD O. MORICAL and LAWRENCE E. ALLWARDT**
Head of Power Mechanics and Assistant Professor of Industrial Education and Graduate Student, respectively,
Stout State College, Menomonie, Wis.

Auto mechanics students are often faced with the problem of getting "hard-starting" automobiles to run. These hard-starters may be their own student "jalopies" or the cars on which they will work if they become commercial auto mechanics after graduation.

Too often, however, instead of making a systematic investigation to discover the reason for "hard-starting," the student merely presses the starter and hopes for the best. Usually his only results are a harsh grinding of the starter and a run-down or even ruined battery. Because the concept of a logical and orderly approach to "trouble shooting" is unfamiliar to him, he may then start by hit-or-miss to replace points, condenser, etc. Of course, this haphazard approach is inefficient and potentially expensive both in parts and labor costs.

### Logical Troubleshooting

As an auto mechanics instructor, one of the most important techniques that you can teach your students is the use of a logical, systematic approach to locating the source of trouble in hard-starting engines. For achieving this objective, the attached chart has proved valuable over a period of years. It has purposely been kept simple so that even a beginning student can use it effectively. In any case, the multiple steps of employing this chart and later referring to its contents will indirectly reinforce for your students the concept of logic and order in automobile engine diagnosis.

One successful method for its use will be described in this article. However, because the technique is quite flexible, you can easily modify it to fit your particular shop situation.

First, merely duplicate the chart by inexpensive mimeograph, spirit duplicator or any similar process, thus making available to each student his individual copy. Next, in the instructional area of your shop or in a classroom, hold a lecture and discussion period based on the content of the chart to prove the value of a systematic approach in trouble shooting a hard-starting engine.

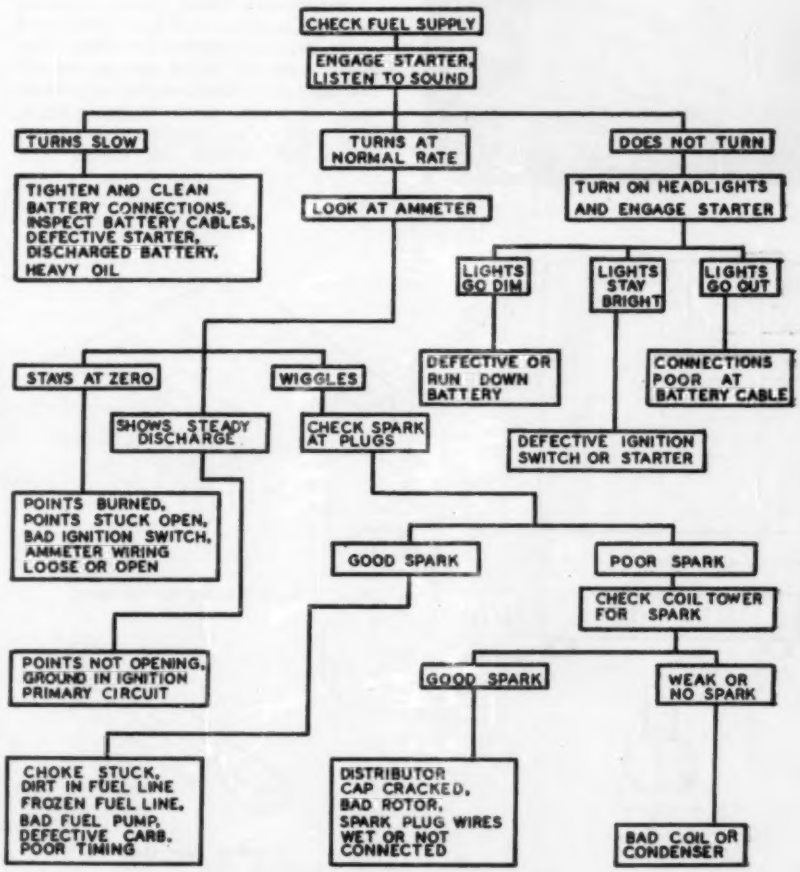
Near the end of the discussion session, inform your students that they will soon be given a timed practical test on a shop engine, with problems purposely "built into" that engine. Be sure to stress the emphasis which will be placed on the use of a systematic approach combined with maximum speed and efficiency. Finally, on a stationary test engine or with a car, trace with the class the steps which the chart suggests for discovering causes of hard starts.

### For Preventive Maintenance

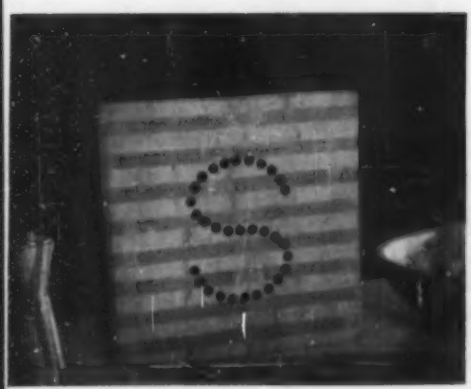
In a semester you will have a number of opportunities to emphasize, perhaps indirectly, how the chart is also of value in preventive maintenance. For example, you may have a chance to demonstrate an actual situation in which a loose battery cable nearly necessitated battery replacement. In such a case, point out that action of the ammeter gave warning of future electrical difficulties. In late autumn, suggest that a "check-chart" examination of a car in October can prevent a lot of pushing and pulling in January. Of course, these constant reminders of the value of orderly procedure will help reinforce facts which your students learned from the original demonstration.

The check chart is, of course, not a cure-all, nor can it be expected to describe in detail every possible engine difficulty. Rather, it is meant to impress upon the student the necessity of a systematic approach in diagnosing the cause of difficulty in starting an automobile engine. Once the student is familiar with a standard procedure for trouble shooting, you can allow him to expand his approach as he gains more proficiency. ◀

## TROUBLE SHOOTING CHART
FOR AN
ENGINE WHICH FAILS TO START


CHECK FUEL SUPPLY
ENGAGE STARTER, LISTEN TO SOUND
TURNS SLOW
TURNS AT NORMAL RATE
DOES NOT TURN
TIGHTEN AND CLEAN BATTERY CONNECTIONS, INSPECT BATTERY CABLES, DEFECTIVE STARTER, DISCHARGED BATTERY, HEAVY OIL
LOOK AT AMMETER
TURN ON HEADLIGHTS AND ENGAGE STARTER
LIGHTS GO DIM
LIGHTS STAY BRIGHT
LIGHTS GO OUT
STAYS AT ZERO
WIGGLES
DEFECTIVE OR RUN DOWN BATTERY
CONNECTIONS POOR AT BATTERY CABLE
SHOWS STEADY DISCHARGE
CHECK SPARK AT PLUGS
DEFECTIVE IGNITION SWITCH OR STARTER
POINTS BURNED, POINTS STUCK OPEN, BAD IGNITION SWITCH, AMMETER WIRING LOOSE OR OPEN
GOOD SPARK
POOR SPARK
CHECK COIL TOWER FOR SPARK
POINTS NOT OPENING, GROUND IN IGNITION PRIMARY CIRCUIT
GOOD SPARK
WEAK OR NO SPARK
CHOKE STUCK, DIRT IN FUEL LINE FROZEN FUEL LINE, BAD FUEL PUMP, DEFECTIVE CARB. POOR TIMING
DISTRIBUTOR CAP CRACKED, BAD ROTOR, SPARK PLUG WIRES WET OR NOT CONNECTED
BAD COIL OR CONDENSER

# THE BUTCHER BLOCK CUTTING BOARD



**A. PRENTICE STILLMAN**
Alfred-Almond Central School
Alfred, N. Y.

This cutting board is very popular with the students and it is useful and a well-received project at home. The many variations which are possible in this project are limitless. We have made them of maple, birch, walnut, cherry, maple and walnut, maple and birch, and maple and cherry. The closer, hard grained woods work the best. The block in the picture was inlaid with ebony made from old black piano keys which were turned on the lathe. For the most part scrap lumber can be used for this project. If you have some badly split lumber this too can be salvaged and used.

To start with, all of the lumber should be of equal thickness, about ¾ in. The width of each block may vary to suit the lumber available. Cut strips of wood about 20 in. long by ¾ to 1½ in. wide. The lengths of these strips could be shorter but then you will need more strips.

Joint the edges of each strip and glue these edges together in a pleasing combination until you have about twelve inches in width of glued up board. For best results use waterproof glue. Make sure these boards are fairly even on the surface in the gluing process. You will need at least two such glued-up boards for this project depending upon the length of the strips you have.

When the glue is dry, remove the clamps and scrape off all surface glue. Cut these boards, on the circular saw, into strips anywhere from 1¾ to 2 in. long. Using the jointer push stick, joint both surfaces of each strip across the grain. Have your jointer sharp and set to take a very thin cut.

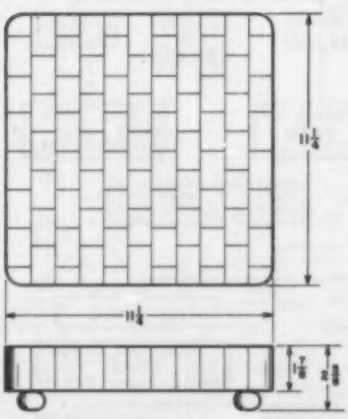
When each strip has been jointed they may be glued together side by side taking care to have the joints mismatched. Before clamping use a 2 by 2 or some similar object to help keep the strips from bending and breaking apart. Try to keep the surface of the cutting board flat and level when gluing.

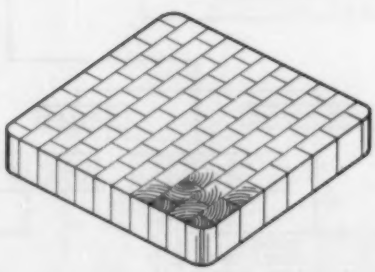
When the glue is dry, remove the cutting board from the clamps and scrape off all excess glue. The block should be as nearly square as possible. The four edges may be run across the jointer to make them even.

Using a portable belt sander, sand off the surfaces of the cutting board using first a coarse grit (1/0) sander belt and then a very fine belt (3/0). The sanding should be done gradually and not too long at one time as the heat generated will cause the wood to shrink and may cause checks in the wood. The four edges may now be sanded with a power sander and the corners rounded. All arrises are slightly rounded. The block may be further finish-sanded all over with 6/0 garnet finishing paper by hand.

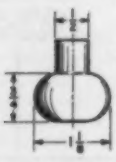
If legs are desired on this block, they may be made at this time. They are turned on the lathe out of one piece of wood and then cut apart after thoroughly sanding each one. Four holes should be drilled about 1½ in. from each side of each corner for the shank of the knob leg. Glue the leg into the cutting board.

To finish the cutting board we have found that paraffin ironed into the entire surface with a warm flat iron works about the best. When the paraffin has cooled rub down the whole surface with 2/0 steel wool until it is very smooth. No wax should remain on the surface of the wood.

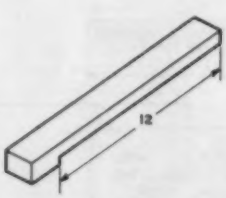


BUTCHER BLOCK CUTTING BOARD



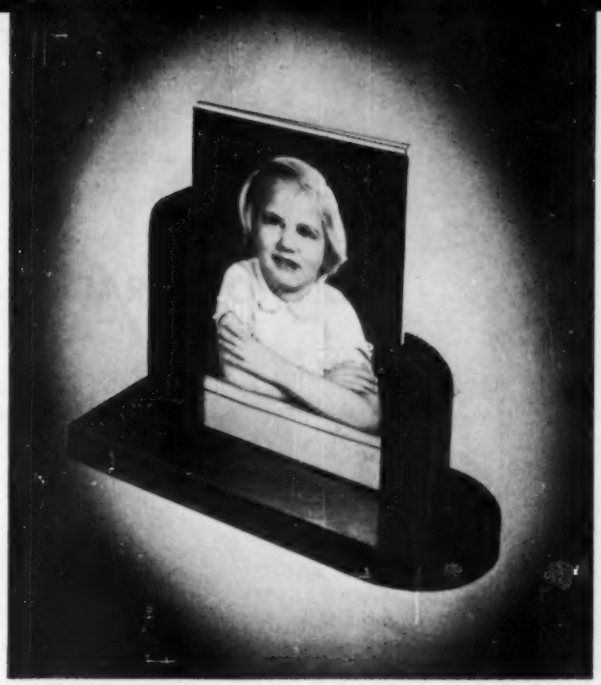

KNOB LEG




JOINTER PUSH STICK

# A MODERN PICTURE FRAME

**ROBERT L. KINGSLEY**
James Monroe Junior High School
Tulsa, Okla.

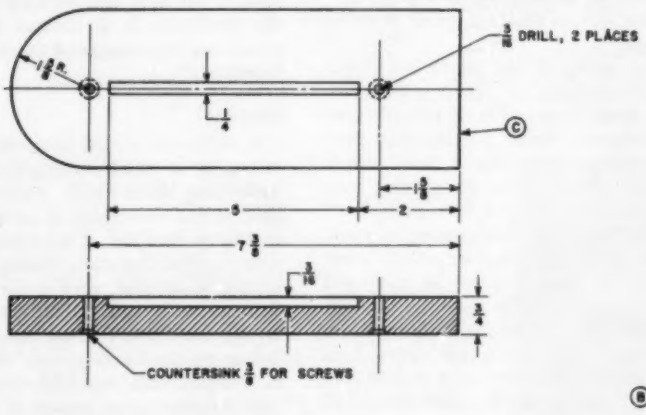


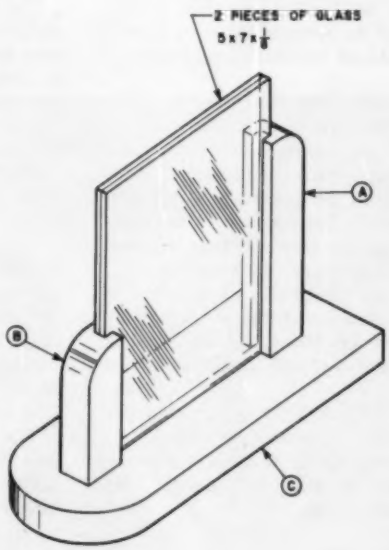
For your beginning woodwork students have you ever wished you had a project that would use a major portion of the hand tools? This modern picture frame uses 17 of the basic hand tools. In the process of making the frame the student learns a variety of hand operations in the jack plane, try square, marking gauge, chisel, coping saw, wood file, hand drill, round shank drill, brace, countersink bit, awl, compass, screw driver, backsaw, dovetail saw, vise, and a hand screw clamp.

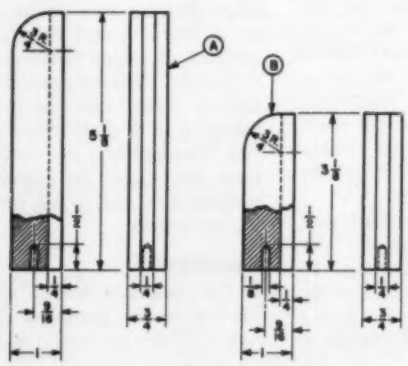
A short cut in making the prongs of this modern picture frame is to square both prongs at the same time. Square a piece of 1 in. stock to ¾ by 1 by 9 in. Lay out the ¾-in. radius for the tops of the prongs 3⅛ in. from one end and 5⅛ in. from the other end. Cut the radius of the prongs with a coping saw or jig saw. Between the jaws of a hand screw clamp, evenly place the tops of both prongs; square the radius of both with a file in one operation.

The groove in the prong is either cut by the instructor with a circular saw or by the student using a dovetail saw and a chisel. The groove in the base is made by drilling a series of 3/16-in. holes 3/16 in. deep and 5 in. long with the hand drill or drill press. Remove the remainder by using a chisel, keeping the edges straight and neat.

In making the base and prongs the student learns the procedure for squaring a block. This foundation of all woodwork projects is easier learned when the student is able to make a project that appeals to him. And in the process he learns to use many of the basic hand tools!




NOTE: 2 NO. 8 1¼ FLAT HEAD WOOD SCREWS REQD.

▶ The equipment, supplies, and physical facilities needed to —

# ADD PHOTOGRAPHY TO YOUR PROGRAM

THOMAS NOWACKI

Photography, probably the most neglected phase in the industrial arts program, can be easily included in most general shop programs with a lot of initiative and little initial expense. It is a natural interest "getter" on the junior high level. The potentials of a shop photo area are great. Much work can be done with the Boy Scouts, school year book, adult education, plus the possibility of exploring the vocational and avocational aspects of photography.

### Photography in Science and Industry

If industrial arts is to portray some aspects of the industrial world, then photography deserves its own niche. The importance of photography in industry, science, commerce, and research cannot be questioned. The use of photography by doctors, dentists, police, and all of the services put it in a position of almost limitless possibilities.

### Photography Statistics

Very few shop teachers are aware of the statistics dealing with photography. If facts and figures make some teachers aware of the potentials of photography, then a few supplied by the Eastman Kodak Co. should help to visualize the broad coverage of photography.

1. About 55 per cent of the families in the United States take pictures.
2. There are about 27 million people who use about 42 million still and movie cameras.
3. About 2,550,000 people consider photography as their main hobby.
4. Total sales of photo merchandise, both amateur and professional, were $2.3 billion during 1959.

### The Darkroom

The construction of a corner darkroom is very simple. It would make a swell project for a woodworking class to build. If a small room is available, then the cost of building a darkroom is greatly reduced.

**Mr. Nowacki teaches at Poland Central School, Poland, N. Y.**

The minimum dimensions of a darkroom which would be adequate for a general shop program would be about 4 by 6 by 8 ft. high. The framing can be built from 2 by 2's and the framing covered with wall board. A calking gun is used to seal out the light where the wallboard meets the shop walls. It is not necessary to paint the inside of the darkroom black.

Benches in the darkroom should be built sturdy so as to avoid vibration when enlarging. Covering of the bench tops with sheet plastic that has an adhesive back makes an excellent and inexpensive working surface. Racks for holding various equipment can be easily devised.

The door of the darkroom needs special attention so that it is perfectly light proof. You can build several types of darkroom doors, but basically they are nothing more than a door with a built-in light trap or an opening into the darkroom that is a light baffle.

The light trap door shown is made from 1 by 2½ in. strips of wood placed on edge. A piece of wallboard is then nailed to the frame along with several cross braces for rigidity. Strips of wood 1 by 1½ in. are nailed flush around the doorway to complete the baffle. Felt stripping is applied all around the outside of the door except for the hinged side. On the hinged side nail a strip of canvas over the entire length of the door so as to cover the crack between the door and the darkroom. Make sure that you allow enough slack in the canvas for opening and closing the door. Paint the canvas so as to help seal out any light.

The doorway light baffle illustrated provides excellent ventilation for the darkroom. The main disadvantage to this type is the space that it takes up. The interior walls of this opening should be painted flat black. A dark curtain is used at the entrance of the doorway so as to help stop any light reflections.

### Ventilation

Two air vents are needed in most darkrooms. The vents should be about 8 by 8 in. by 2 ft. long. A strip of cardboard, which acts as a baffle is on the inside of the darkroom. One vent should be placed high and the other low in the darkroom wall. The inside of all air vents should be painted flat black.

A small exhaust fan installed in the darkroom wall is a great convenience, especially during hot weather. Be sure to purchase an exhaust fan that has a built-in light trap or else you will have to make one for it. The purpose of the exhaust fan is to remove stale air from the darkroom. It is obvious that you would not want to force fresh air into a darkroom.

### Electrical

A darkroom should have about four outlets so as to accommodate the usual equipment along with regular white light and a safe light. A good ground should be provided if an electric print dryer is used. Naturally electrical safety should be stressed when doing work of this nature. A good darkroom should always have a dry towel available for drying off the hands in case they come in contact with any chemicals. Good housekeeping in the darkroom certainly means that the floor should be kept dry at all times. A wet darkroom floor is evidence of sloppy technique.

It is not absolutely necessary to have running water inside the darkroom, although it is a great convenience. If a sink is located near the darkroom it will serve the purpose for mixing chemicals, washing films and prints and for cleaning equipment.

### Equipment

The equipment needed will vary according to the degree of photography taught. There are basic equipment needs

that are required if good results are to be expected. Some equipment can be built or obtained secondhand thus reducing the cost. In photography you can find a lot of "frill" equipment at photo supply stores. This equipment does not necessarily mean that it will produce better work automatically, but in most cases it produces convenience.

### Chemicals

It is generally the best policy to stick to one brand of chemicals. Switching chemicals too frequently leaves a person wondering whether poor work is the result of the chemicals or technique.

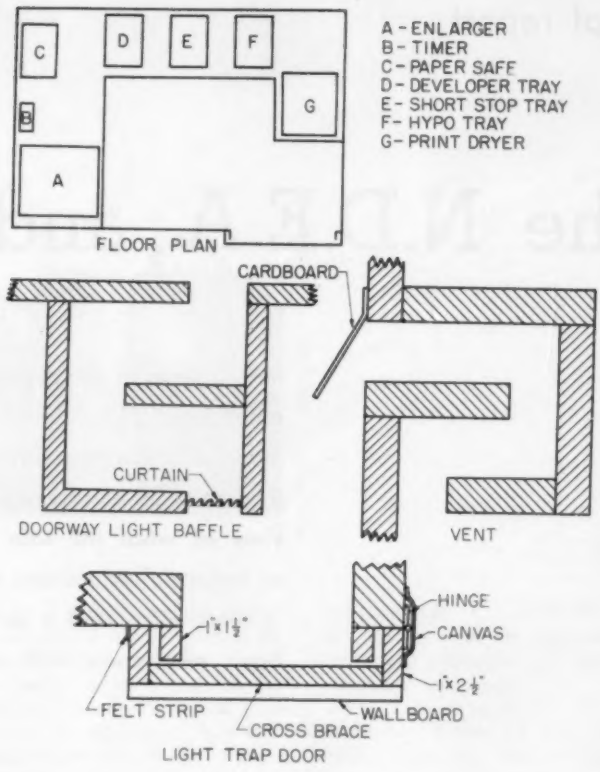
It is a good idea to mark equipment used with developer so that it is always used in developer and not any other chemical. The equipment to be marked should be: 1 tray, 1 graduate, 1 print tong, 1 funnel, storage bottle, and 1 stirring rod. The easiest way to mark them would be with a dab of colored enamel. Equipment used in hypo and short stop can be intermixed without harm.

There are several photographic supply companies that make excellent chemicals. Listed are the Kodak chemicals because they are usually easier to obtain in most localities. Problems dealing with photography will be readily answered by the educational divisions of Eastman Kodak Company, Rochester 4, N. Y., or Ansco, Binghamton, N. Y. Operators of local photo supply stores are more than willing to supply information.

### Photographic Processes

The main operations that would be covered in a general shop program would be: film developing, contact printing, and enlarging. It would be best to read several photography books and then adapt the readings to your particular situation. You must expect some variations in readings about processing due to the use of different equipment and chemicals.

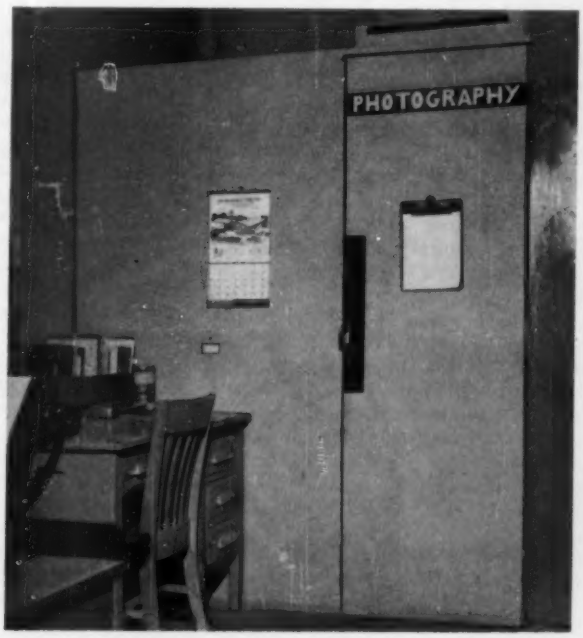
Once you have set up processing techniques for your particular equipment and chemicals, then you can expect the best possible results within the limitations of your setup. ◀




| *CHEMICAL* | *USE* |
|---|---|
| DEKTOL | Used to develop prints and enlargements |
| D76 | Used to develop film |
| M.Q. | Universal developer, for films and papers (basic only) |
| ACETIC ACID 28% | Used in making short stop |
| ACID FIX | Called hypo, used to fix films and papers |
| PHOTO FLO | A whetting agent that prevents water marks |

*EQUIPMENT*

| *Basic* | *Advanced* |
|---|---|
| 1 Print box | 1 Enlarger, 2¼" x 3¼" size |
| 3 5" x 7" trays | 1 Automatic timer |
| 1 Thermometer | 1 Electric print dryer |
| 2 Developing tanks (ratchet type) | 3 8" x 10" trays |
| 2 Print tongs | 1 Print washer |
| 6 Film clips | 1 Paper safe |
| 3 Ferrotype plates | Various size enlarging papers, glossy, single weight, F.2 |
| 1 Ferrotype polish | 1 Paper easel |
| 1 Print roller | |
| 1 Blotter roll | |
| 1 Amber safe light (for papers only) | |
| 1 Graduate, 32 oz. size | |
| 2 Funnels | |
| 1 Towel | |
| 1 Plastic apron | |
| Several containers for chemicals | |
| Various size contact paper, glossy, F.2 | |



special report

# The N.D.E.A. and Electronics

**In two years of stimulating expanded programs in "area vocational education," Title VIII of the National Defense Education Act has made concrete and substantial contribution to the development of the study of electronics. The following report presents an overview of what the title means to this phase of the curriculum of industrial education, a guide to the scope of a good program in electronics, and a survey of how to set up a low-cost shop in basic electronics with a listing of basic equipment needed —**

## AN OVERVIEW OF OBJECTIVES AND REGULATIONS

W. M. ARNOLD

One of the outstanding contributions of Title VIII of the National Defense Education Act to more effective technical training, attested to by many vocational educators throughout the country, has been the provision in the law that funds paid to a state may be used in approved programs for the purchase, rental, or other acquisition, and maintenance and repair of instructional equipment. Obviously, there are two important aspects of this provision: one dealing with the law itself and the regulations, the other pertaining to meeting the objectives of the training program.

The important factors involved from the standpoint of the law (P.L. 85–864) and the regulations (Misc. 3560), which have the effect of law, are:

1. The funds are allotted to the states and the states are authorized to approve the programs and expenditures for equipment within the provisions of their respective state plans.

2. The funds are allotted to states in the same proportion that each state receives all other George-Barden funds.

3. The Federal funds must be matched dollar for dollar with state and/or local funds.

4. The equipment must be directly related to instruction or, in other words, peculiar to the occupation for which the training is offered.

5. The Federal government has a continuing interest in the use and disposition of any equipment purchased with Federal funds. The general purpose here is to make the most effective training use of the equipment as long as the program is in operation.

**Dr. Arnold is director of Area Vocational Education, Office of Education, Washington.**

— Harry A. Goldstein

**Electronics Equipment**

With respect to meeting the training objectives of the program, the electronics or electrical equipment should:

1. Duplicate or simulate industrial equipment wherever possible.
2. Provide for multiple units of basic training. Advanced training may be done with individual units — demonstration units in some cases.
3. Be adequate to provide the basic items necessary for at least one work station for every two students.
4. Include training aids that will improve technical and learning efficiency.
5. Represent a range of cost and quality for comparative purposes.
6. Include some precision standards for checking and calibrating laboratory test equipment.
7. Be placed in the laboratory so as to be most efficiently used by students and teacher.
8. Be replaced and added to, to offset obsolescence and to provide for constantly changing technology.
9. Be protected and maintained in good working order so as to be available for instruction at all times.
10. Include a file of service manuals for all laboratory testing and measuring equipment.

It should not be overlooked that consumable supplies are essential to the effective use of equipment.

The total authorization of Federal funds under Title VIII is $15,000,000 for each of four years, ending June 30, 1962. The appropriation in the first year of the program, fiscal 1959, not a full school year, was $3,750,000. Of this amount $1,572,802.96 was expended for equipment. Inasmuch as electronics and electrical preparatory programs were approximately 50 per cent of the total programs, it is obvious that equipment expenditures were most significant in the development of these programs.

Approximately 30 per cent of the $7,000,000 appropriation for fiscal 1960 was expended for equipment. It is estimated that 59 per cent of the preparatory programs operating in 1960 were electronics and electrical programs.

The fiscal 1961 appropriation is $9,000,000. At this time it is difficult to foresee what proportion of the funds will be expended for equipment, but in all probability a considerable number of programs will be improved by the continued acquisition of testing and measuring equipment.

The Federal funds for 1962 will be determined largely by what the states indicate they will need for the further expansion and improvement of Title VIII programs. In any case, it can be safely concluded that the provision for the purchase of equipment in Title VIII has proved to be the most important one in getting programs underway. ◀

## tips for setting up a title VIII program

1. Be sure the need for the training has been clearly identified (in the immediate area, state-wide, or nationally). Know what the job opportunities will be for graduates.
2. Conduct a student interest survey to assure that there will be an adequate number of able students who will be interested in such a training program.
3. Organize and use to the maximum a representative advisory committee, the members of which have had rich experience in the fields of electronics and electricity.
4. Visit schools that operate similar programs and discuss curriculum and equipment needs.
5. Consult closely at all times with the state supervisor who has been assigned the responsibility for approving Title VIII programs. Use the forms and procedure adopted by the state to apply for approval of the program and any equipment involved.
6. Plan and adopt an intensive rigorous curriculum which includes all the necessary related technical courses, all of which are designed to meet the objectives of the program. Office of Education publications OE-80006 and OE-80009 will be helpful in this planning.
7. Obtain adequate space for housing the necessary laboratories and classrooms. (Provide for the safe care and protection of valuable instruments.)
8. Prepare lists of equipment, instruments, tools, etc., with the assistance of the advisory committee, a technically competent instructor, consultants or specialists in the field, and the technical sales representatives of manufacturers.
9. Set up a student selection program based on well-defined entrance requirements. Make allowances for experience, maturity, and other evidence of ability to make progress in the training program.
10. Start early with an information program designed to acquaint the general public with the new program.

# WHAT TO TEACH

The following is an outline of a course of study for four years study of electricity-electronics. It was developed by the department of public instruction of the State of Hawaii under industrial arts education director, Frank N. Kanasaki.

While most states have similar guides as to what can be taught in programs for the above subjects, the following curriculum was completed in September of 1960 and represents current trends in these programs in the light of NDEA stimulation.

It has been published with the hope of providing a yardstick to measure the individual district's present offerings or to help other districts initiate such an offering.

## electricity-electronics 1 & 2

### I. ORIENTATION

The student, before attempting the study of a subject matter, should have an overview of the objectives. It is also important in this course that the student learn the necessity of a safe, clean and orderly physical plant.

A. Objectives
   1. General education outlook
   2. Conceptional and factual learning
   3. How to seek information
   4. Manipulation as a laboratory experience
B. Safety
   1. General safety measures in a shop
   2. In case of an accident
      *a*) What to do?
      *b*) Artificial respiration
   3. Fire safety and what to do
   4. Lifting and moving heavy objects
C. Housekeeping
   1. Cleaning schedule
   2. Duties
D. Physical plant
   1. Tools and their care
   2. Power machinery and regulations

### II. BASIC FUNDAMENTALS OF ELECTRICITY

The entire study of electricity will be based on the electron theory. It is assumed, that all electrical and electronic effects are based on the theory of the movement of electrons from place to place or that an unbalanced number of electrons exists in a particular place. You will learn what an electron is and what causes it to move in a material.

A. Structure of matter
   1. Molecules
   2. Atoms
   3. Electrons
   4. Protons
   5. Nuclei
B. Electron theory
   1. Potential differences
   2. Electron drift
   3. Ionization

### III. STATIC ELECTRICITY

This is a study of the electro-static field between two bodies charged oppositely. One body has an added number of electrons; therefore, it is called negatively charged. The other has electrons removed; therefore, it is called positively charged.

A. Electrostatic charges
   1. How it is produced
   2. Laws of charged objects
B. Effects
   1. Condenser action
   2. Interference

TESTING . . . I–III

### IV. CURRENT ELECTRICITY

Atoms of molecules in a material are in constant random motion. The random movements of free electrons from atom to atom in the same direction and the net electron movement for flow is called current flow.

A. Direct current
   1. How it is produced
   2. Uses
B. Alternating current
   1. How it is produced
   2. Uses
C. Pulsating direct current
   1. How it is produced
   2. Uses

INDIVIDUAL PROJECTS

### V. INSULATOR AND CONDUCTOR

Did you ever stop to think how it is that some materials are good carriers of electricity and others are very poor carriers. This unit will help you to understand it.

A. Insulator
   1. Definition
   2. Uses
   3. Kinds
   4. Insulation of conductors
   5. Manipulation
      Test insulators for breakdown factors
B. Conductor
   1. Definition
   2. Uses
   3. Kinds
   4. Semi-conductors
   5. Manipulation
      Test the resistance for different sizes of wire and materials

### VI. SOURCES OF ELECTRICITY

Electricity is the flow or action of electrons. Some form or energy is necessary to be converted into electricity. You will have the opportunity to study some of the six forms of energy which can be converted to electricity.

A. Chemical
   1. Dry cell
   2. Wet cell
      *a*) Electrolyte
      *b*) Ionization
      *c*) Electroplating
   3. Manipulation
      Dismantle and construct cell
B. Mechanical
   Detail with generator study
C. Thermal
   1. Electric range (heating appliances)
   2. Welding
D. Photo
   Detail with illumination
E. Pressure (piezzo-crystal)
F. Friction

TESTING . . . IV–VI

### VII. METER READING TECHNIQUE

When you work with electricity, it is necessary that you determine the values of the force acting or being acted upon. A meter is used to evaluate the values by making a comparison with standards.

A. Ammeter
   1. Range
   2. Polarity
B. Voltmeter
   1. Range
   2. Polarity
C. Ohmmeter
   1. Series type
   2. Zero adjustment

### VIII. OHM'S LAW

Ohm's Law is the basic relationship of current, voltage and resistance. The current flow of a circuit varies in the same direction as the voltage and varies in the opposite of the resistance change.

A. Voltage
B. Current
C. Resistance
D. Manipulation and application
   1. Set up circuitry
   2. Calculate values with constant
   3. Test values with meters

# the NDEA and electronics

### IX. POWER

Power is the rate of doing work. What is work?

A. Definition of work
B. Definition of energy
C. Mechanical power (conversions)
D. Electrical power
   1. Watt-hour
   2. Watt-hour meter reading
   3. Problem solving

TESTING . . . VII–IX

### X. ELECTRICAL CIRCUITS

An electric circuit is a completed electrical pathway, consisting of a conductor, the path; a switch, the control; an appliance, the load; and the cell, the source. You will construct roads for electrons and build devices to regulate their path.

A. Series
   1. Make circuitry
   2. Test for values
B. Parallel
   1. Make circuitry
   2. Test for values
C. Combination
   1. Make circuitry
   2. Test for values
D. Simplification of circuitry

### XI. ELECTRICAL WIRING

A civil engineer who is constructing a road makes a study of the conditions and requirements. It is the same with electrical wiring — the pathway of electricity. You will acquaint yourself with various conditions in electrical wiring.

A. Wire size
   1. Unit of measurement (mils)
   2. Wire tables
   3. Gages
      *a*) Wire
      *b*) Caliper
      *c*) Micrometer
B. Kinds of wiring cables
   1. Armored
   2. Non-metallic sheathed
   3. Underground
   4. Conduit
C. Joints and splices
   1. Kinds
   2. Where used
   3. Manipulation
      *a*) Tying conductors
      *b*) Soldering conductors
      *c*) Connecting terminals
      *d*) Lugging
D. Insulation
   1. Kinds of insulation and insulators
   2. Techniques
E. Protection
   1. Safety
   2. Control
   3. Fuse or circuit breaker
   4. Safety code requirements

### XII. ILLUMINATION

How does the electric lamp give out light? This unit will give you a working knowledge to that question.

A. Lamps
   1. Incandescent
   2. Gas discharge
   3. Mercury vapor
   4. Electro-luminescent light source
   5. Fluorescent
B. Manipulation
   1. Inspect components of lamps
   2. Test materials in lamps

TESTING . . . X–XII

### XIII. MAGNETISM

Magnetism is an invisible force and can be understood only in terms of the effects it produces. Like the wind, it provides force.

A. Theory
B. Natural
C. Temporary
D. Permanent
E. Magnetic and non-magnetic materials
F. Manipulation and application

### XIV. ELECTRO-MAGNETISM

When an electric current flows in a wire, an electro-magnetic force is induced. How is it so?

A. Theory
B. Magnetic polarity of a coil
C. Induced voltage
D. Ampere turns
E. Manipulation and application
   1. Make an electro-magnet
   2. Test for polarity
   3. Reverse the polarity
   4. Vary its magnetic field strength
   5. Make a relay switch

### XV. DIRECT CURRENT MOTORS AND GENERATORS

You are familiar with the flash-light battery, it is a source of electricity but not too strong. Now, you want a source of electricity which can supply you with all the electricity you need. What can do it? The generator.

A. Series
B. Shunt
C. Compound
D. Advantages and disadvantages
E. Manipulation and application
   1. Dismantle the different kinds
   2. Trace the current flow
   3. Construct a motor

TESTING . . . XIII–XV

### XVI. ALTERNATING CURRENT

A current that flows first in one direction through a circuit and then reverses itself and flows in the opposite direction is called an alternating current. You will become acquainted with the principles upon which this phenomenon works.

A. EMF
   1. By magnetic field
   2. Value of induced
B. Single-coil A-C current generator
C. Definitions
   1. Cycle
   2. Frequency
   3. Period
   4. Phase angle
   5. Wave
D. Voltage
   1. Variation
   2. Peak or maximum
   3. Instantaneous
   4. Average
   5. Effective or RMS

### XVII. CAPACITORS AND CAPACITANCE

Does your refrigerator have a capacity to store ice cream? Yes. When you need some to serve to your guests, it is there ready. The capacitor works in like manner with modifications.

A. Structure
   1. Plates
   2. Dielectric
B. Functioning concept
   1. Charging
   2. Discharging
   3. Discharged
C. Dielectric
   1. Effect
   2. Strength
D. Capacitor network
   1. Series
   2. Parallel
   3. Series-parallel
   4. Parallel-series
E. Kinds of capacitors
   1. Cylindrical
   2. Flat discs
   3. Variable
   4. Electrolytic
   5. Ceramic
F. Behavior of capacitor with A-C
   1. Capacitor action
   2. Angular velocity

### XVIII. INDUCTOR AND INDUCTANCE

Inductance opposes any change in circuit current. When the current increases, inductance holds it down. When the current decreases, inductance holds it up.

A. Phenomena of induction
   1. A magnetic field around a conductor
   2. Primary-secondary relationship
B. Induction
   1. Self
   2. Counter
C. Effects
   1. Single-layer
   2. Multi-layer
   3. Core
   4. Lamination
D. Kinds of inductors
   1. Air wound
   2. Core wound
   3. Special shaped
   4. Variable
E. Inductor network
   1. Series
   2. Parallel
   3. Series-parallel
   4. Parallel-series
F. Behavior of inductors with A-C

(Continued on page 42)

# EQUIPPING THE BUDGET SHOP

LARRY E. HILLER

The rapid rise of the interest and activity in the electronics field has brought to many schools the need for a new approach to electronics training. This often requires a new shop and its associated equipment. While the assistance available under the National Defense Education Act is of considerable help, many schools still have budget problems and the following article is the result of the author's experience in setting up and operating a shop for basic electricity and electronics.

The basic philosophy set down for our approach to electronics training was formulated by industrial training directors and stresses the great importance of a sound knowledge of the basic principles of electricity and of electronics. The fact that the industry is moving ahead at such a terrific pace eliminates the advantage of training students on specific pieces of gear.

This laboratory is designed to allow the use of manuals already approved by the electronics industry, so that the instructor does not have to spend many laborious hours devising and proving out laboratory experiments, but can move into a good training program at once. This low-cost laboratory will allow the student to build up his experiments, test them with instruments such as he would find on the job, disassemble the parts without damage, and allow the following class to utilize the same parts kits in whatever phase of the program they happen to be engaged.

The teaching method employed is that of a lecture or demonstration at the beginning of each laboratory period, supplemented by audio-visuals pertinent to the subject at hand and followed by practical work in the laboratory.

The laboratory has been designed on the basis of a 16-student class, working in groups of two men in each group for a total of eight bench positions. The course material to be covered consists of basic electricity and basic electronics from which the student branches into one of the communications fields or into industrial electronics. This article will discuss the shop needs on the basis of physical facilities and on the basis of equipment for the class outlined above.

**Mr. Hiller is an electronics instructor at the West Allis School of Vocational and Adult Education, West Allis, Wis.**

## Physical Facilities

The bench space available to each two-man group should consist of about six feet of work surface. It should be equipped with a bench light, if available, or it should be adequately lighted for many small and sometimes difficult-to-identify parts are used. The back of each bench should be equipped with at least two duplex receptacles for the connection of equipment and a source of 110-volt power.

Distribution of low voltage power may be handled in very fine shape by individual power supplies, or it may be done on the basis of a power distribution board. The power board is expensive as well as inflexible at times so the writer tends to favor the individual unit system.

A pair of terminals is provided at the back of each board for power distribution from a central source when it might become necessary. Another set of terminals is connected from board to board by a co-axial cable which may

**A listing of minimum equipment for a 16-student class**

### Kit Parts

*Resistors (½ watt)*

| | | |
|---|---|---|
| 4.7 Ω | 1200 Ω | 100 K |
| | 1200 Ω | |
| 10 Ω | 2200 Ω | 270 K |
| 15 Ω | 3300 Ω | 470 K |
| | | 1 M |
| 22 Ω | 4700 Ω | 1.5 M |
| | | 1 M |
| 33 Ω | 4700 Ω | 2.2 M |
| | | 4.7 M |
| 47 Ω | 5600 Ω | |
| | 6800 Ω | |
| 100 Ω | 10 K | |
| 330 Ω | 10 K | |
| 470 Ω | 15 K | |
| 470 Ω | 47 K | |
| 1000 Ω | 47 K | |
| 1000 Ω | 47 K | |
| 1000 Ω | 100 K | |

*Resistors (10 watts or larger)*

| | |
|---|---|
| 5 Ω | 5000 Ω |
| 300 Ω | 20 K |
| 500 Ω | |

*Capacitors (8 of each)*

| Tubular — 600 v. | Small Disk & Mica |
|---|---|
| .001 mf. | 1000 mmf. |
| .001 mf. | 1500 mmf. |
| .002 mf. | |
| .005 mf. | 250 mmf. |
| .02 mf. | 47 mmf. |
| .5 mf. | 47 mmf. |
| .05 mf. | 47 mmf. |
| .1 mf. | |

*Electrolytic Capacitors (8)*

50 mf. — 25 v.

*Potentiometers (2 watt)*

500 Ω
10 K
500 K
Volume control bracket, AB 550

8 Power transformers
8 Power cords
8 Filter capacitors
16 Filter chokes
8 Ground bus
8 Output transformers
24 Battery holders

*Tubes*

8 — 6H6
8 — 6J5
8 — 5U4
8 — 6K6
8 — 6SN7
8 — 6SK7
8 — 1N34 diode

*RF Coils and Variable Capacitors*

8 — 200 mh. chokes
8 — 30 mh. chokes
8 — Hartley oscillator coils — standard broadcast
8 — Ferri-loopstick antennas — standard broadcast
8 — Tuning capacitors — 365 mmf.

*Miscellaneous (for jobs 1 and 2)*

32 — 5 point — center ground terminal strips
16 — Octal sockets
16 — Sheet metal bases
8 — Electrolytic capacitors
8 — Mica capacitors

be used to distribute high frequency signals, or wave forms, or may be connected to an antenna, should the shop ever be used for radio or television work.

Benches should be of the closed type if possible, as much of the test equipment is easily subject to damage. There is also the usual problem of security.

Wall cabinets, if possible, also will provide for additional storage facilities. Space for construction, development, and repair for the instructor is desirable, but not absolutely necessary in the small shop.

### Equipment

The shop equipment is divided into two classifications — experimental kits and test equipment. The experimental kits are available on a commercial basis and are very good. We wished to have the ability to store a partially completed hookup which is necessary when the more complicated devices are constructed and our approach to the problem was slightly different, allowing us to secure the parts to the pegboard base, and invert the whole setup into the storage box.

The storage boxes are made of poplar wood which is light and does not split easily. They were sanded and given two coats of shellac. The tops were cut from standard pegboard sheets, fitted into the groove in the top edge of the storage box. The initial boxes are 16 by 24 in. in size which fitted well into the base cabinets. Boxes which contain the supplementary parts which we use in industrial electronics circuits are built on a 12 by 16-in. base.

Parts for the experiments are mounted on plastic bases, the resistors being mounted in groups of five as was the case with the smaller capacitors.

In each parts base there is an 8–32 screw extending downward which mounts the part to the pegboard with a knurled thumb nut. All electrical terminals are brought up on 1½ in. by 6–32 brass screws for easy connection by miniature alligator clips. Using this system the student can connect a fairly complicated circuit, test it, and disassemble it in less than two hours. The kit idea is liked by all students, ranging from post high school to maintenance electricians with 30 years of teaching experience.

The author has never found a system which allowed the student to advance as rapidly, or taught him as well. The instructors will find that the versatility of the kit will increase day by day as he finds new uses for the parts contained therein.

The lucite for the parts bases was obtained from local fabrications as scrap, as many small pieces were used, ranging from 1 by 3 in. to 4 by 5 in. Other plastics might be used, depending on the supply source.

The use of the foregoing materials and instruments has met the needs of this school in admirable fashion, resulting in a course which was interesting and well received. The author has never found a situation which created more interest and resulted in a more rapid assimilation of the fundamentals of electricity and electronics than has the E.I.A. course coupled with this laboratory setup. It has been more than satisfactory to the student as well as the instructor. ◀

8 — Ceramic capacitors
24 — Resistors
32 — Resistors
32 — Capacitors

### Hardware

24 Socket shells
8 Selenium rectifiers — 500 ma.
8 Silicon rectifiers — 500 ma.
7 gross 1½-in. 6–32 FH machine screws
7 gross 6–32 machine screw nuts
2 gross ¾-in. 8–32 FH machine screws
2 gross 8–32 knurled thumb nuts
7 gross soldering lugs
200 ft. Black hook-up wire, stranded
200 ft. Red hook-up wire, stranded
200 ft. Yellow hook-up wire, stranded
200 ft. Green hook-up wire, stranded
200 ft. Blue hook-up wire, stranded
200 ft. Orange hook-up wire, stranded
3 gross Miniclips

### Tools

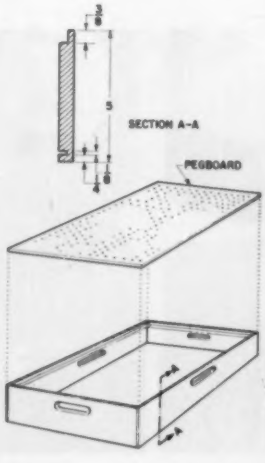
3 — Soldering guns
3 — Soldering irons
2 — Soldering pencils
4 — Nut driver sets
4 — ⅛ by 4-in. screw drivers
4 — ¼ by 6-in. screw drivers
4 — Combo screw drivers
4 — Gas pliers
4 — Diagonal cutters
4 — Long nose pliers

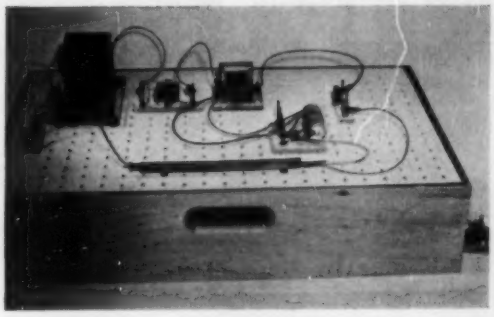
### Minimum Test Equipment

4 — 0–1 d.c. milliammeter, 3-in.
8 — 0–10 d.c. milliammeter, 3-in.
(Shunts for 20 ma. and 100 ma.)

These meters should be mounted in cases similar to Bud No. 1936 and equipped with a normally-closed push-to-read switch.

12 Bud cases, CMA 1936
4 V.T.V.M.
4 Voltohmist
2 Power supplies
2 Power supplies
6 Power supplies
4 — Oscilloscopes
1 — AF generator
1 — Sine- and square-wave generator
1 — RF generator
1 — Sweep generator (kit)
1 — Tube tester
2 — Variac



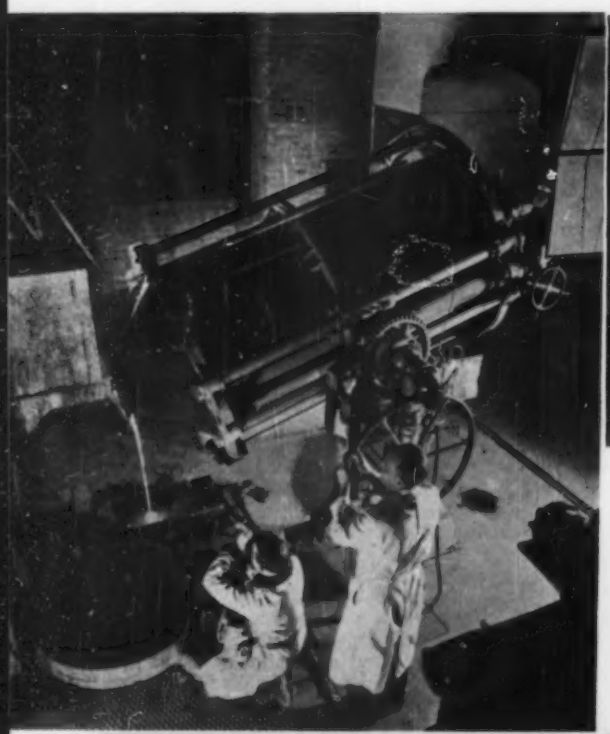



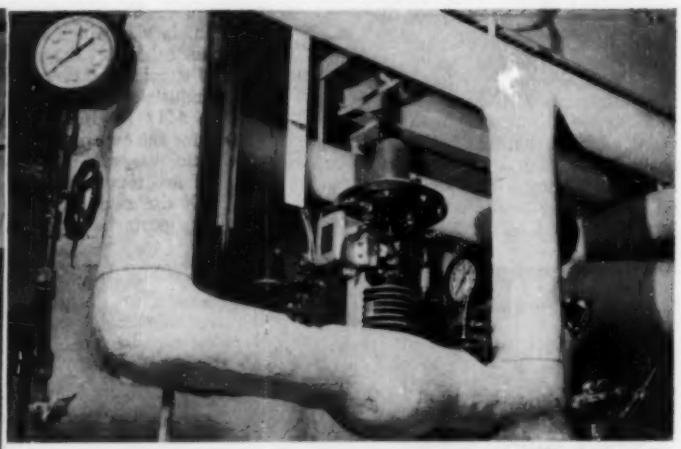
profiles in industry

▶ This survey of an industry basic to industrial education **defines the dynamic field of instrumentation, indicates how industry uses instruments, defines the jobs available** in the field, and looks for **trends in the future —**

# Instrumentation and Control

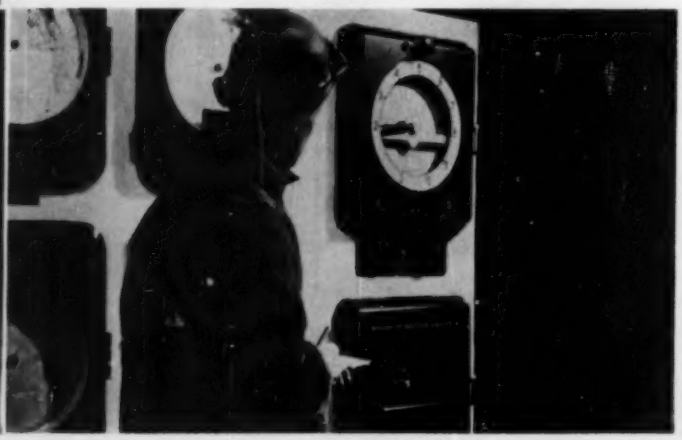
**LAWRENCE E. MALEY**





— The Foxboro Co.

Left: Temperature measurement using optical pyrometer to check temperature of molten frit — the glass coating on porcelain enamel. Above: control value used as final control elements. Lower, left: temperature measurement using thermocouple to measure temperature of molten iron before pouring into foundry molds. Below: instrument technician checking refinery controls.



You have perhaps heard of the future possibilities of an automatic plant or factory. Even today, plants and processes are becoming more and more automatic but it is still not possible to purchase a completed packaged automatic plant or process. The automation that is available comes about by the use of more and more instrumentation and control devices.

These instrumentation and control devices do not appear out of nowhere; nor do they apply themselves to the problem automatically; nor can they install and maintain themselves. Somewhere, somebody designed and built the instrument or control system; someone else may have determined how to apply the instrument or control device to his particular problem; and a third man may have had the responsibility of installing and maintaining the equipment. All of these jobs fall in the field of instrumentation and control and would have been handled by instrument engineers, technicians, or mechanics.

## I. Why Instrumentation and Control

Instrumentation is the basic tool of science and industry. It probes the unknown, strengthens our defense, increases our national productivity, our standard of living. Instrumentation concepts and equipment dominate our daily lives — in our homes, our factories, plants and offices, our cars, planes, ships, guided missiles, satellites, etc. Instrumentation truly symbolizes the current age of technology.

Although improving the efficiency of already established production processes is one of the vitally important contributions of industrial instruments and controls, in some fields the process itself could not have come into being without automatic controls. This dependence upon instrumentation accounts for its spectacular growth in the large central steam generating stations and in many continuous processes, such as the refining of petroleum products and the manufacture of many kinds of chemicals.

The instrument and control industry is one of the fastest growing, one of the most dynamic in the nation. In fact the rate of expenditures for meters and controls has increased twice as fast in the last 15 years as has that for other capital goods.

## II. What Are Instruments and Controls

Instruments and controls play a vital role in the operation of all important scientific and industrial fields today. A few of these fields are: (1) aeronautical, (2) nuclear, (3) chemical, (4) petroleum, (5) metals, (6) glass and ceramics, (7) pulp and paper, (8) public utilities, (9) food, (10) medical, (11) rubber and plastic, (12) missile and space, (13) electronics, and (14) electrical manufacturing.

**Mr. Maley is Chairman of the Vocational Advisory Committee, Instrument Society of America, Pittsburgh, Pa.**

Instruments and controls are based on many engineering principles. They involve the knowledge and use of: (1) mechanics, (2) optics, (3) electronics, (4) hydraulics, (5) pneumatics, and (6) mathematics.

The devices which are designated as instruments and controls are used to *measure, indicate, record, and control* almost any type of variable encountered in this wide variety of industries. Such variables as *temperature, pressure, flow, velocity, liquid level, position, density, composition* are measured and controlled in these industries in order to manufacture products more efficiently, maintain a uniform quality, and exercise control over safety of operation.

In all of its essentials, instruments and controls are the most diversified and yet the most specific products in the present age of automation. Just as instrumentation is not confined to any particular industry, it is not confined to any definite area or enterprise. Instrumentation is used out in the process plant, on our networks of power and communication, inside the laboratory, on the oil or gas drilling rig, and within the confines of a rocket, missile, or a business office.

It should be pointed out that, although almost all of the basic physical and chemical principles are used in the design, operation, and application of instrument and control devices, it is not essential that each instrument engineer, technician, or mechanic be an expert in all these fields. A general understanding of the basic principles of optics, mechanics, electronics, etc., is certainly of great value but the field is so large and expanding so rapidly that many specialists are required in each specific area.

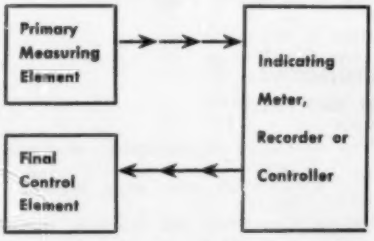



Fig. 1

To illustrate some of these instrumental devices and the functions they perform, let us look at a simplified instrument control system. Figure I illustrates the elements which compose a standard control system.

The primary element is used to measure a change in some variable. Some variables which are measured by instrumental devices are:

*Temperature* is the most important variable to industrial processes. Nearly every process has one or more temperatures associated with its operation. Heat flow may occur in any body and it is determined by measuring associated temperature differentials. It is not as easily directed, however, as the flow of fluids, because flow of heat does not necessarily involve physical motion of bodies.

*Fluid-flow* control is a means not only of proportioning the materials introduced into a process but also of supplying energy for purposes of automatic control. For example, the control of feed to a stabilizer column in an oil refinery is necessary in order to maintain the proportion of materials in the column. Another example is found in the control of temperature which may be accomplished by adjusting the flow of steam to the process.

*Pressure or vacuum* control is important in the operation of many continuous chemical processes; it is often associated with temperature conditions. For example, in handling multiple-phase liquids such as water or hydrocarbon compounds, the control of pressure is as important as the control of temperature. Another example is the control of furnace or boiler draft in metal-processing and power plants.

*Liquid-level* control is essential in continuous distillation processes and in many other industrial operations. Liquid level, however, is closely associated with both fluid flow and pressure. Pressure controllers are also commonly used for the control of liquid level.

*Humidity* control is important in air conditioning and the processing of foods and textiles. Humidity may be measured by means of dry- and wet-bulb temperatures, partial vapor pressure, evaporation, or physical expansion. Control of humidity by wet- and dry-bulb temperatures is the most common.

Some devices used to measure these variables are: thermometers — liquid and gas filled, thermocouples, radiation pyrometers, flowmeters, manometers, pressure gauges, and liquid level meters.

Once the variable is measured an indication is given on a suitable indicating device such as a meter or recording potentiometer. If a control action is to take place some signal may be fed back to a final control element. The majority of instrumental devices are not used as controllers but simply as measuring and indicating devices. Control systems are used quite extensively in the process industries — food, chemical and metal working, and anyone contemplating entering these fields should

have a basic grasp of the functions of a control system.

The final control element is the mechanism used to cause a change or adjustment to the measured variable. The final control element may be a valve, damper, louver, pump, motor, etc.

### III. How Industry Uses Instruments

We have briefly discussed why the instrumentation and control field developed and what are the basic principles and functions of the instrumental devices. Let us now consider how instruments are used in some typical industries.

### A. *Automotive Industry*

Instrumentation activities are quite extensive in the automotive industry. The outline below details a few of these activities.

### B. *Chemical and Petroleum Industry*

In the chemical and petroleum industry, instruments and controls are the tools which guide the operator in getting the desired product quality from a processing unit at the lowest cost. They provide him with information and aid in holding a unit steady or they control it directly. This helps to compensate for routine changes in operating conditions or unforeseen upsets.

For example, instruments are used to control feed rate (flow), the level of materials, temperatures, and pressure in a vessel, furnace, reactor, etc. Additionally, other instruments are used to continually measure the quality of the product being made. Frequently, they may be used to automatically vary conditions so as to hold the desired quality.

The main object of this is to keep the cost of operation as low as possible, relieve operators of tedious mechanical routine, or prevent unsafe operating conditions.

In many new chemical and petroleum plants the capital expenditure for instruments and control devices runs beween 15 and 30 per cent of the total cost of the plant. On a plant costing approximately $8.0 million this means $1.5 to 2.5 million might be spent on instrumentation. In a typical plant this would consist of more than 1000 major instrument units and nearly 1000 minor units.

### C. *Nuclear Industry Instrumentation*

Nuclear instrumentation has known only 15 years of progress compared to more than 15 decades for many other industries.

While reactor control is an important phase of this field, it is only a small portion to the instrumentation engineer in nuclear industry. He may work with instrumentation for radiochemical plants which recover fissionable materials from irradiated fuel elements, or in the recovery of radioactive isotopes. He may work in the development of nuclear instrumentation for medical and scientific uses.

In the fundamental research studies concerned with the fission and fusion of elements the instrumentation engineer provides the scientist with services he requires to measure and control variables associated with the experimental programs. In nuclear research programs the instrumentation engineer can and does contribute much to solving the basic secrets of nature.

The future of the instrumentation engineer in nuclear industry is unlimited; however, he must be better prepared for his position than in any more prosaic industries.

### D. *Instrumentation in the Pulp and Paper Industry*

The importance of being able to measure, and to control, the physical elements of a manufacturing process can be clearly illustrated in the pulp and paper industry.

Until men devised ways to measure temperature, pressure, rate of flow, alkalinity and acidity, speed, thickness, and strength, the basic procedure for making a sheet of paper had changed in only minor details over the several thousand years since the Chinese made the first sheets, one at a time, by hand.

Knowing how to accomplish these measurements, often continuously, we have been able to cut logs into chips, cook the chips to form wood pulp resembling brown cotton, brush and treat the pulp to add strength, and then form it into sheets 25 feet wide and many miles long, so cheaply that you can throw almost any paper bag or box away after a single use. Before instrumentation made its contribution, a single sheet of paper was used and reused until it literally fell apart, and paper for writing purposes was only for the very wealthy.

Today, improved instrumentation and control shows the way to paper furniture, clothing, building material, and even inflatable satellites for improving television transmission.

### E. *Food Industry*

In the food processing industry instruments control the conditions necessary for uniform and safe food processing. The chart records provided by the continuously operating instruments are often required by state or federal health laws. Some typical applications of instrumentation in the food industry are pasteurization of milk and beer, tempering of chocolate, refining of sugar and sterilization of containers. Instrumentation is used to automatically control a potato chip cooker.

### F. *Railroad Industry*

Instrumentation has been used for many years in the railroad industry in conjunction with non-destructive testing of materials and equipment both for right-of-way and rolling stock. Included in this category are X-ray and gamma radiography, magnetic particle testing, ultrasonic inspection, and eddy current examination particularly of rails. Instrumentation has also been used to a great extent in the evaluation of power plants and completely equipped dynamometer cars for testing of locomotives under actual operating conditions have been used by many railroads.

In more recent years, the trend on many railroads has been away from testing and toward applied research which has considerably broadened the instrumentation applications. Many studies are now being made of accelerations and vibrations encountered in the rail environment and complex accelerometer systems recording their signals on magnetic tape for later analysis are being used. Railroads are also making extensive use of radioisotopes for such applications as wear studies, self-luminous light sources, insulation testing and density determinations, and these spe-

(Continued on page 50)

**OUTLINE OF AUTOMOTIVE INSTRUMENTATION ACTIVITIES**

A. Function of Instrumentation Personnel
   1. Development of special instrumentation
   2. Application of commercial instruments to automotive problems
   3. Calibration and maintenance of instruments

B. Fields of Instrumentation Activities
   1. Measurement of vehicle performance on the road
      *a*) Acceleration, braking, ride, handling, etc.
      *b*) Fuel economy, temperatures, vibration, wear, endurance, etc.
   2. Measurement of vehicle and component characteristics in the laboratory
      *a*) Engine dynamometer measurements
      *b*) Vibration and noise measurements
      *c*) Component and accessory measurements
   3. Development of circuits and instruments used in the vehicle
      *a*) Starter, generator, battery system control
      *b*) Ammeters, speedometers, engine temperature indicators, fuel gauges, lighting systems, etc.
      *c*) Special instrumentation such as automatic operation of the vehicle on the highway

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| ETI- 5 | BASIC D-C CIRCUITS | ☐ |
| ETI- 6 | D-C NETWORKS | ☐ |
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| ETI-12 | A-C CIRCUITS | ☐ |
| ETI-13 | VACUUM TUBE CHARACTERISTICS | ☐ |
| ETI-14 | A-C POWER SUPPLY | ☐ |
| ETI-15 | VOLTAGE DOUBLER & TRIPLER | ☐ |
| ETI-16 | AUDIO AMPLIFIER | ☐ |
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## THE NDEA AND ELECTRONICS

(Continued from page 35)

### XIX. PHASE RELATIONS AND IMPEDANCE

You will learn about the many variable factors which effect alternating current.

A. Phase relations in inductive circuit
   1. Wave pattern
   2. Vector diagram
B. Phase relations in capacitive circuit
   1. Wave pattern
   2. Vector diagram
C. Phase relations in resistive circuit
   1. Wave pattern
   2. Vector diagram
D. Impedance of R-L circuit
   1. Voltage and current vectors
   2. Impedance vector diagram
   3. Equivalent circuit
E. Impedance or R-C circuit
   1. Equivalent circuit
   2. Voltage and current vector
   3. Impedance vector diagram
F. Resonance

### XX. TRANSFORMER ACTION AND TRANSFORMERS

Do you recall hearing someone saying, "this motor runs on 110 volts" or 220 volts? How is this change in voltage brought about? This unit will explain and give you an idea of this action.

A. Inductance
   1. Between coils
   2. Mutual
   3. Coupling
B. Kinds of transformers
   1. Step-up
   2. Step-down
   3. Autotransformers
   4. Spark coil
   5. Vibrator-type
   6. Multi-winding
   7. Radio-frequency

TESTING . . . XVI–XX

### XXI. INTRODUCTION TO RADIO

You must have looked into a radio and must have wondered what makes this thing reproduce sound and music. What are the tubes for or this and that thing? This unit will give you an introduction to radio reception.

Radio Reception
   1. Crystal radio receivers
   2. Regenerative receivers
   3. Tuned R-F receiver
   4. Superheterodyne receivers

## Electricity-Electronics 3 & 4

### I. VACUUM TUBES

High vacuum diodes are primarily used as rectifier (detector) of alternating voltages. It is highly important that the student becomes thoroughly familiar with diode characteristics since they are used in every type of electronic equipment.

The most simple amplifier tube is the triode. There is a wide application of it in various electronic devices.

The pentode tube finds its application in electronics where high voltage gain or low power is required. Its low interelectrode capacitance merits its use in UHF spectrum. Because of their wide application, pentode characteristics are high on the list of important subjects the student must know.

A. Development and use
B. Electron emission
   1. Thermionic emission
   2. Secondary emission
   3. Photoelectric emission
C. Types of emitters
   1. Directly heated
   2. Indirectly heated
D. Emitter materials
E. Diodes
   1. Construction
   2. Operation
   3. Space charge
   4. Diode tube characteristics
      *a*) Static
      *b*) Dynamic
   5. Gaseous tube
F. Triodes
   1. Purpose of the grid
   2. Construction of control grid
   3. Control grid action
   4. Characteristic curves of triodes
   5. Amplification factor
   6. Dynamic characteristics of triodes
      *a*) Load resistor
      *b*) Load line
   7. Interelectrode capacitance
G. Tetrodes
   1. Physical construction of screen grid
   2. Purpose of screen grid
   3. Advantages and disadvantages
   4. Negative resistance region
H. Pentodes
   1. Physical construction of suppressor grid
   2. Types
      *a*) Sharp cutoff
      *b*) Remote cutoff
   3. Characteristic curves
   4. Beam power tube
   5. Pentodes as triodes
I. Multigrid and multiunit tubes
J. Miniature tubes
K. Cathode ray tubes
L. Microwave tubes
M. Phototubes
N. Gas-filled tubes
O. Transmitting tubes

### II. POWER SUPPLIES

In this unit, the practical application of the basic concepts and parts previously discussed in the first course, Electricity and Electronics 1 & 2, is expanded. The power supply system, because of its function in all types of equipment and because of its direct use of the fundamental principles of tubes, resistors, inductors, and capacitors, provides a good starting point for discussion.

The study of power supplies involves the study of rectifier tubes, rectifier circuits and filter circuits.

It is to the students' advantage to learn the types used as well as factors affecting proper operation of power supplies.

A. Rectifier tubes
   1. High vacuum rectifiers
   2. Mercury vapor rectifiers
   3. Controlled rectifiers (thyratrons)
B. Rectifier circuits
   1. Half wave rectifier
   2. Full wave rectifier
   3. Bridge rectifier
C. Rectifier tube ratings
   1. Maximum peak current
   2. Maximum average current
   3. Maximum peak inverse voltage
D. Dry disk rectifiers
E. Filter circuits
   1. General consideration
   2. Choke input
   3. Capacitor input
   4. Swinging choke
   5. Voltage regulation
   6. Bleeder
   7. Multisection filters
F. Voltage divider
G. Types of power supplies
   1. A.C. — D.C. type
   2. Transformer type
   3. Voltage multiplier type
   4. Vibrator type
H. Dynamotors

## III. AMPLIFIERS

One of the most important functions of vacuum tubes is their function as amplifiers. It is important that the student obtain a thorough knowledge of amplifier circuits as well as their characteristics and methods of coupling.

The distinction between the power amplifier and the voltage amplifier is also discussed here.

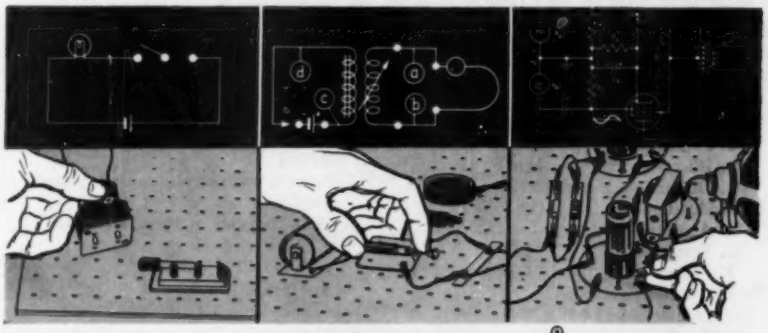
To familiarize the student with the operation and uses of various types of phase inverter circuits and push-pull amplifier circuits.

A. Voltage amplifiers
B. Classification of amplifiers
   1. Audio frequency amplifiers
   2. Radio frequency amplifiers
   3. Video amplifiers
   4. D.C. amplifiers
C. Modes of operation
   1. Class A
   2. Class B
   3. Class AB
   4. Class C
D. Distortions
   1. Frequency
   2. Amplitude
   3. Phase
   4. Others
E. Types of bias
   1. Cathode or self bias
   2. Fixed bias
   3. Contact bias
   4. Grid-leak bias
   5. Combination bias
F. Multistage amplifiers
G. Types of coupling
   1. R.C. coupling
   2. Inductive coupling
   3. Impedance coupling
   4. Direct coupling
H. Gain
   1. Low frequency
   2. Mid-frequency
   3. High frequency
I. Amplifier instability
J. Push-pull amplifier
K. Phase inverters
L. Types of feedback
   1. Positive
   2. Negative
M. Grounded grid amplifiers
N. Cathode followers
O. Decibels
P. High and low frequency compensation circuits
Q. Equivalent circuits
R. Power amplifiers
   1. Characteristics
   2. Power amp vs. voltage amp
S. R.F. amplifier circuit considerations
   1. Parasitic oscillation
   2. Neutralization
      *a*) Plate
      *b*) Grid
      *c*) Cross

## IV. OSCILLATORS

Oscillators can be found in practically every system of communications and radar. The student, therefore, should have a thorough knowledge of the principles and characteristics of oscillators.

A. Introduction
B. Conditions for oscillation
C. Operation
   1. Feedback voltage
   2. Grid leak bias
D. Types of oscillators
   1. Armstrong
   2. Hartley
   3. Colpitts

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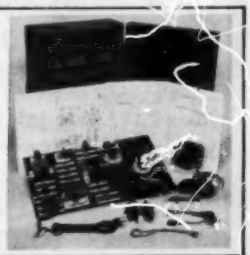

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A. Electromagnetic waves
B. Propagation of radio waves
   1. Polarization
   2. Effects of the ionosphere
   3. Diffraction and refraction
C. Modulation
   1. Amplitude
   2. Frequency
   3. Phase
D. Types of transmission
   1. Double sideband
   2. Single sideband
   3. Vestigial sideband
   4. Suppressed carrier
E. Radio frequency spectrum
F. Bandwidth

## VI. AM RECEIVER CIRCUITRY

Since radio receivers are an integral part of an electronic communication system, the student must have a firm grasp of the important basic aspects of receiving systems in general.

The over-all operation as well as the alignment of the various circuits in the superheterodyne receiver is also explained in this unit.

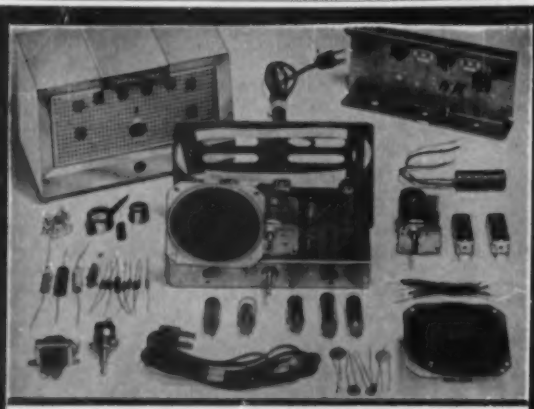
A. Detection or demodulation
B. Types of detectors
   1. Diode or crystal
   2. Plate
   3. Infinite impedance
   4. Grid leak
   5. Regenerative
C. Heterodyne detection of C.W.
D. Filtering of detector output
E. Purpose and operation of I.F. amplifier
F. Purpose and operation of commuter circuit
G. Purpose and operation of r.f. amplifier section
H. Purpose and operation of a.f. amplifier section
I. Purpose and operation of a.f. power amplifier
J. Characteristics of radio receivers
   1. Sensitivity
   2. Selectivity
   3. Fidelity
K. A.V.C. (automatic volume control)
L. Alignment
   1. I.F. section
   2. Osc-mixer section
M. Tone control circuit
N. Types of receivers
   1. Superheterodyne
   2. Super-regenerative
   3. T.R.F. (tuned radio frequency)
O. Troubleshooting hints and techniques

## VII. AMPLITUDE MODULATED TRANSMITTERS

A. High level modulation
B. Low level modulation
C. Types of r.f. power amplifiers
D. Neutralization
E. Frequency multiplier circuits
F. Types of modulation
   1. Plate
   2. Grid
   3. Cathode
   4. Screen grid
G. Balanced modulators
H. Doherty amplifier
I. Carrier frequency stability
J. Buffer amplifier
K. Driver amplifier

## VIII. ANTENNAS AND TRANSMISSION LINES

A. Transmission lines
   1. Reflected and standing waves
   2. Characteristic impedance
   3. Phase relationship of voltage and current
   4. Standing wave ratio
   5. Types of transmission lines
      a) Coaxial
      b) Twin lead
   6. Matching stubs
   7. Wave guides and cavities
B. Antenna
   1. Function
   2. Radiation resistance

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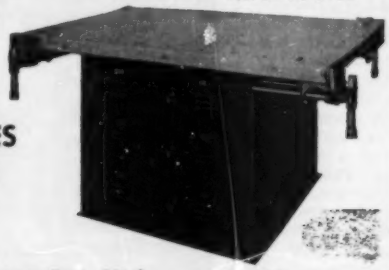

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## NEWS

(Concluded from page 9)

### western's working workshops

The industrial education department at Western Michigan University, Kalamazoo, conducted its fourth annual industrial education workshop with more than one hundred high school industrial education teachers participating. Believed to be unique in their functional in-service value to industrial education teachers, this workshop is composed of several instructional areas in which a limited number of participants work under the tutelage of a specialist in each instructional area. Those areas included in the 1960 workshop were: wood finishing, applied welding, automotive tune-up, crystal radio, power mechanics, tumbled jewelry craft, and ceramic tile work. To make the workshop of maximum value to the participants, the Saturdays of the workshop have been divided into morning and afternoon sessions. Each enrollee participating in the workshop spends 2½ hours in one instructional area during the morning session, and 2½ hours in a different instructional area during the afternoon session. While in each of these instructional areas, the participant is actually engaged in a concentrated short course of instruction. Within the time limits of the session

he receives brief, but thoroughly concentrated instruction, physically engages in the production or manipulation and testing of a three-dimensional application of the instruction and evaluates the quality of the instruction.

### new courses

The New York State University's Agricultural and Technical Institute at Farmingdale has announced a new course in "highway and bridge technology." The program was established to meet the nation's growing need for technicians for expanding expressway and bridge projects. The two-year course covers such subjects as structural design, drainage, structures, mapmaking, surveying, etc.

### on technical writing

Stout State College, Menomonie, Wis., now offers a course in what is termed "the fastest growing segment of American journalism—technical writing." Trained to organize scientific facts and then write and publish them in partnership with engineers on one hand and technicians on the other, the technical writer will have taken a four-year course program in technology and a blending of writing, printing, and photography.


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# associations

## WHAT HAPPENED AT THE 1960 MEETING OF THE INDUSTRIAL ARTS CONFERENCE?

If you happened to be in the lobby of the LaSalle Hotel in Chicago from Wednesday evening to Saturday morning, November 9 to 12, you would have recognized many familiar faces in positions of leadership in industrial education. This was the annual "gathering of the clan" for the 47th meeting of the Industrial Arts Conference. About 60 of the 65 members were in attendance, as were about 30 guests.

Many of our readers are acquainted with this organization, but for some who are not, here are some things you might be interested in knowing about it. This is a group made up primarily of the heads of departments in colleges and universities in the Mississippi Valley area. There are also four members from state departments, two from city schools, and two from the major educational journals. This is a very unusual professional gathering. There are no officers and the members pay no dues. Dr. Verne Fryklund of Stout State College has been serving as chairman of the conference for many years. Before that, Dr. Bawden acted as permanent chairman. The conference is devoted to discussions of five major problems in the area of industrial education, one topic considered each of the five sessions which annually are scheduled. At each of the sessions a short report is presented by two or three members of the conference and the remaining time is given to discussion and friendly argument among all of the members. This year, as usual, there were five excellent reports.

On Thursday morning, Dr. Karnes, University of Illinois, Dr. Klehm, Eastern Illinois University, and Dr. Grinstead, Central State College (Missouri), discussed the topic, "Changes in Content in Industrial Arts to Meet the Needs of a Technological Age." Dr. Klehm raised three questions with regard to industrial arts in the junior high school.

1. Should shop teachers assume some responsibility for teaching science, mathematics, and English?

2. Is there a danger that we will get away from the unique contribution of industrial arts and devote too much time to topics not directly related to developing skill?

3. Is industrial arts in the junior high school really representing our technological age?

Dr. Klehm suggested that perhaps, even at this level, we should make greater use of power machinery and that we should emphasize the basic principles that are implied in technology. He felt that we should attempt to inject more solid content into our junior high school industrial arts. Dr. Grinstead suggested that at the senior high school level, we should give more attention to the interpretation of industry and that technical information should be emphasized. Dr. Karnes discussed this matter with reference to industrial arts teacher education. He proposed that we needed more industrial arts teachers who had specialized in one area, and that we could not offer a really good industrial arts program except in the larger high schools. He felt that the industrial arts teacher needs greater technical competency in an area specialization. He also suggested that prospective industrial arts teachers spend their summer months in industrial employment. Obviously, not all of the conference members agreed with these proposals and many recommendations were made from the floor.

The Thursday afternoon meeting was probably one of the most interesting that it has been our pleasure to attend. Dr. London of the University of Missouri, and Dr. Secrest of Northern Illinois University gave an illustrated talk on life, education, and work in Russia. Dr. London spent several weeks in Russia last spring, visiting schools as a representative of the American Vocational Association. Dr. Secrest was in Moscow with the American exhibit where his contribution was the power tools. Their colored pictures of life in Russia were most fascinating, and we feel sure that the members learned more about Russia from this two-hour session than would have been possible through extensive reading. These men brought back the impression that the average person in Russia is a satisfied, but sullen individual. There is a very minimum level of consumer goods


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available, the average person is without running water and has a living space of perhaps one eighth that of the average American family. No one has refrigeration and the use of fuel for cooking is limited. Such things as coffee, ice cream, and chewing gum are unknown. The education system of Russia is unique and particularly interesting to people in industrial education. Several critics of American education indicate that Russia is moving toward a more academic type of program. According to Dr. London, this is not true. As a matter of fact, he believes that Russia is moving in exactly the opposite direction! At what is equivalent to our secondary school level, the Russians have an extensive program of what they term "polytechnic education." This is required of all students and is very similar to our beginning industrial arts in wood, metal, and drawing. At the post high school level, Russia is developing hundreds of vocational type schools in which electricity-electronics, metalworking, and other technical subjects are emphasized. Dr. London feels that Russia is doing an excellent job in education.

On Friday morning there was a lively discussion on the topic, "What Are the Functions of Professional Associations such as the AIAA, AVA, NAITE, and State Associations?" The group reporting on this consisted of Mr. Prakken of *School Shop* magazine, Dr. Groneman of Texas A and M, and Dr. Nelson of Ball State Teachers College. The participants reported on the purpose and function of these organizations. However, the main topic of discussion centered around the idea of whether or not there should be one national organization for all industrial education teachers. The question was raised as to whether we can justify two national conventions. There were several very heated discussions on this point, some members suggesting that steps be taken toward the possible unification of all industrial education teachers. There were several very heated discussions on this point, some members suggesting that steps be taken toward the possible unification of all industrial education teachers into one strong national group.

The Friday afternoon meeting was devoted to the favorite topic, "Recent Research in Industrial Arts." Dr. Silvius of Wayne State University distributed a very interesting brochure listing all of the doctoral theses that are available on microfilm. Professor Wenrich of University of Michigan discussed some of the new research being done in the field of industrial arts. They both pointed out that the major trend in our area is toward greater interest in experimental research.

The Saturday morning meeting concerned itself with the question "What the Master Degree Program for Industrial Arts Majors Should Be." Dr. Gallington of Southern Illinois University, Dr. Reed of Iowa, and Dr. Paige of Ohio University reported on this subject. There was some general agreement that there should be greater attention at the master's degree level to technical competencies needed by industrial arts teachers.

As is a policy of this conference, there were no decisions made, no resolutions passed, and no dues collected. This reporter cannot give you an account of what happened across the luncheon tables or in the lobby after each session adjourned, but you can be assured that one of the major reasons that this conference is always such a huge success is that the discussion never stops with the formal meeting but goes on in small groups through the noon and dinner hour, and far into the night. It was good to welcome Dr. Micheels back from Indonesia. — *J. L. F.*

## COMING CONVENTIONS

*Jan. 20–21. California Industrial Education Association — Southern Section,* at Cerritos College, Norwalk, Calif. Secretary-treasurer, Ralph Bishel, High School, Montebello, Calif.

*Feb. 24–25. Texas Industrial Arts Association,* at Texas A. & M. College, College Station, Tex. Secretary-treasurer, Frank Miller, Travis Jr. High School, Snyder, Tex.

*Mar. 2–4. Illinois Vocational Association,* at Chase-Park Plaza Hotel, St. Louis, Mo. Secretary, C. E. Summerville, 103 North Lynn St., Champaign, Ill.

*Mar. 9–11. New Jersey Vocational and Arts Association,* at Berkeley-Carteret Hotel and Convention Hall, Asbury Park, N. J. Secretary, Richard O. Harthman, 236 Lexington Ave., Jersey City.

*Mar. 17–18. California Industrial Education Association,* at Fairgrounds, Fresno, Calif. General chairman, Robert P. Hansler, director of industrial education, Fresno City Schools.

*Mar. 23–25. Ohio Industrial Arts Association,* at Neil House, Columbus, Ohio. Secretary, Robert Boyer, 7463 Midland Rd., Cleveland 31, Ohio.

*Apr. 5–7. American Industrial Arts Association,* at St. Louis, Mo. Program chairman, Robert Swanson, Stout State College, Menomonie, Wis.

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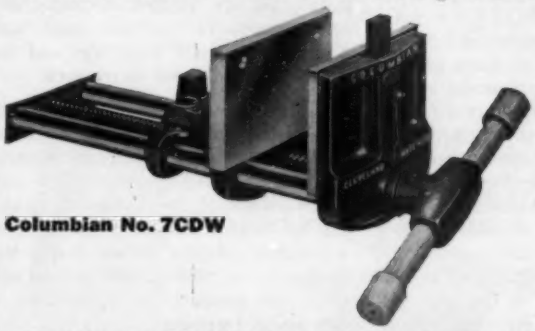

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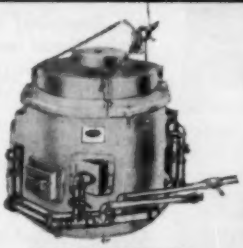

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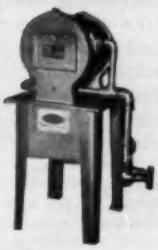

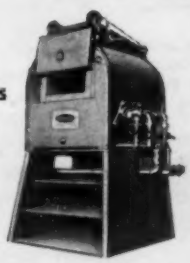

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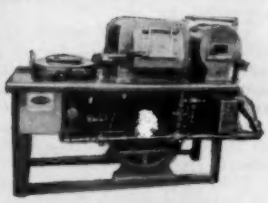

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(Continued from page 40)

cialized fields involve equally specialized instrumentation. Increasing use of automation in the railroad industry by the use of centralized traffic control systems involves signaling and communication research and development requiring extensive instrumentation.

Future instrumentation opportunities in the railroad industry include work on the development of new, more efficient prime movers, the extension of automation throughout rail operations plus a great deal of more basic work on the performance and behavior of roadbed and equipment under widely varying conditions of operation.

### G. *Missiles and Aircraft Industry*

Missiles, rockets, and aircraft offer challenging opportunities in the field of instrumentation. The most advanced optical and radio tracking techniques have been developed to supply the measurements necessary in these fields. Standard instrumentation devices have to be reduced greatly in size and weight in order to meet the requirements of the space age. New techniques are continually being developed in this rapidly advancing field and more and more instruments are required to check out these techniques and provide suitable safeguards in the event of a malfunction.

### H. *Instrument and Control Manufacturing*

The companies which produce the instruments used in the various industries we have mentioned are the largest and perhaps the most rapidly expanding employers of instrument specialists. The instrument and control manufacturers can be broken down into five basic classifications.

1. Industrial instruments — manufacturers of electro-mechanical, pneumatic, electronic and hydraulic control devices, thermostats, voltage regulators, thermometers, pyrometers.
2. Laboratory instruments — manufacturers of specific instruments for laboratory testing — spectrometers, PH meters, refractometers, etc.
3. Nautical, aeronautical, and military instruments — manufacturers of instruments such as gyroscopic compasses, automatic pilots, altimeters, depth gauges, aircraft and marine steering devices.
4. Optical instruments — manufacturers of microscopes, lenses, fluorimeters, photoelectric apparatus.
5. Recorder controller — manufacturers of meters, recording potentiometers, millivoltmeters, graphic panels.

## IV. What Jobs Are Available in the Instrumentation and Control Field

As in any other technical field there are a variety of jobs available and each of these jobs is absolutely essential to the growth and expansion of the field. The jobs available in the instrumentation and control field fall into the same general categories encountered in other technical fields and the duties related to each job are also basically the same.

The same fundamental aptitudes in the engineering sciences apply to both the engineer and technician specialist in instrumentation. Individual interest and ability are usually the determining factors as to whether a young person is suited for a career at either level. While the choice of a technician or engineering career is up to the individual, a certain amount of selection does occur at the high school level through discussion with and guidance from his high school teacher. The young person can be further aided in his decision by an understanding of the positions available in the instrumentation field and tasks performed by a person in each position. The positions available in the instrument industry might be classified as follows:

**1. Research and Development Engineer.** In a rapidly growing and expanding field such as the instrumentation and control field research and development is always being carried on at a vigorous rate. Engineers with a desire to work on instrumentation problems requiring ingenuity, imagination and creative ability are in constant demand by the instrument manufacturers as well as the companies using the instruments in various industrial activities.

**2. Production or Process Engineer.** Once the instruments have been properly developed they must be actually produced and used by industry. It is the function of the product engineer to plan its method of manufacture, inspection and calibration. In order to carry out these duties, he must understand fully the instrument and specifications which it must meet. Process instrument engineers in various industries serve a function somewhat similar to the product engineer but in a much broader manner. The product engineer usually works for an instrument manufacturer and is responsible for one type or class of instrument. The process instrument has the responsibility generally for all types of instrumentation used in the plant in which he is employed. He must select the best instrument available and perhaps supervise the installation and start-up of the device.

**3. Application Engineer.** Application engineers have the responsibility of seeing that the instruments are properly applied by the user, assisting the user in adapting or modifying the instrument if necessary and determining what new instruments are required as the industry expands, improves or changes its methods of production. The application engineer acts as the liaison between the instrument manufacturer and the instrument user.

**4. Sales Engineer.** The instruments and control systems offered for sale by the instrument manufacturers are complex devices and the sales engineers handling this equipment must be qualified professionals. An engineer with a desire to work in many different fields is required since he may find himself attempting to sell his equipment to the steel industry, chemical industry, petroleum industry, etc., simultaneously. A reasonable understanding of the processes and problems in many industries becomes a desirable asset.

**5. Instrument Technician.** The instrument technician builds, installs, maintains, or repairs complex instruments and control devices. If he is employed by an instrument manufacturer, the job usually requires co-ordination work between the engineering department and the shop, testing and calibrating of the device after it has been assembled and perhaps assisting in field servicing of the device. If he is employed by an instrument user his duties are to maintain, service, trouble shoot, and, if necessary, modify instruments in use in the plan in order to keep all of these complex devices operating at all times in an accurate and reliable manner.

**6. Instrument Foreman.** The foreman is usually an experienced instrument mechanic or technician. He is generally responsible for a certain area of the plant and all of the instruments in that area. His job is to see that the instruments which require service or installation are handled efficiently and economically. The foreman must have a broad instrument knowledge and the ability to handle and direct men.

**7. Instrument Mechanic.** The instrument mechanic usually has the responsibility of repairing any instruments which have failed to service. He may repair or rebuild the device but usually has no responsibility for operation of a complete complex system. Instrument mechanics, as they become more proficient, are promoted to technicians or instrument foremen.

## V. What about Technical Societies or Organizations

The explosive growth of instrument technology in the past 15 years has led to the birth of a number of technical societies and organizations devoted exclusively to various aspects of instrument training, education research, and development. Most prominent among these groups are:

(Concluded on page 52)

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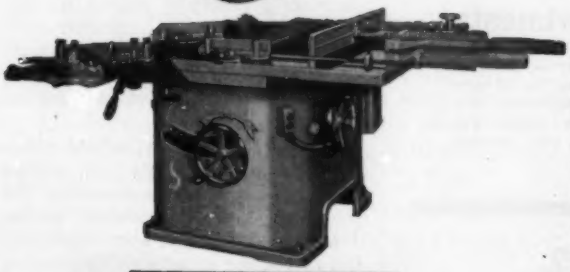
You'll like them for their heavy, vibration-free, smooth running. Each machine is electronically balanced. You'll like their dependability, the freedom from trouble, their excellent safety features. And yes, you'll like the price too. Take all these factors into consideration and compare NORTHFIELD with any others before you buy.



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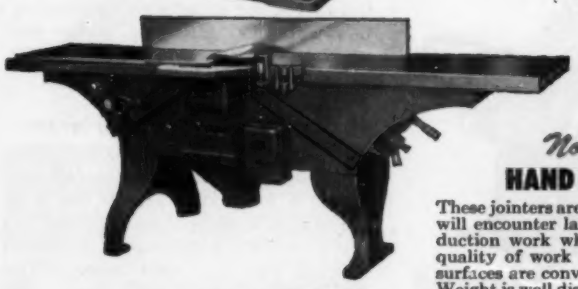
The NORTHFIELD No. 4 Variety Saw is a carefully designed, quality machine with the latest features. It offers maximum versatility for all around sawing in any school shop. In addition to wood it's adaptable for cutting light metals, plastics, and other materials. The table on the basic machine is 44″ x 36″, plus a 19½″ extension for carrying the rip gauge table. One or more 12″ table extensions can be furnished to increase table size. A rolling section table is also available. You'll like this machine for its versatility, heavy duty capacity, ease of handling, and speed with precision.



## *Northfield* HAND JOINTERS

These jointers are of the type the student will encounter later being used for production work where accuracy and fine quality of work are essential. Working surfaces are convenient to the operator. Weight is well distributed to make a well balanced smooth operating machine. The medium duty machine at right is available in eight and twelve inch widths. Tables are 6'2″ long; rabbet depth ⅜″. Heavy duty jointers are available in 12″ and 16″ sizes. Tables are 8′ long; rabbet depth ⅝″. They use a round three or four knife, safety type cylinder head, and a three horsepower, 3600 R.P.M. T.E.F.C. motor; five H.P. motors and belt drive machines also available.

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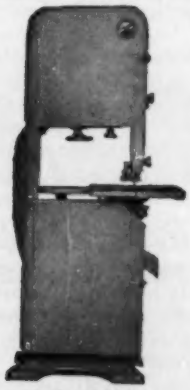

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are available in 20″, 27″, 32″ and 36″ sizes. The 20″ band saw takes 24″ x 36″ in floor space, horizontal capacity is 20″, vertical capacity under guide is 11″.

SHAPER

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are ideal for school shops. They have simplified, high performance, trouble-free, mechanical design. They are available in 18″ x 8″ and 24″ x 6″ sizes.



(For more information from advertisers, use the postcard on page 65)

## INSTRUMENTATION

(Concluded from page 50)

**1. The Foundation for Instrumentation Education & Research (FIER).**

The Foundation for Instrumentation Education and Research was organized in early 1957 through the efforts of a planning group of scientists, engineers and businessmen mobilized by the Instrument Society of America. The Board of Directors of the Foundation is composed of executives from industry, education and government with a strong interest in technical education and wide background experience in the technology of Instrumentation and Control. It is the Board's responsibility to act as Trustees for the donations to the Foundation and to see that these funds are used in a meaningful and objective way.

FIER Directors form the Committees which make policy and run foundation projects within its Aid to Technical Education Program. A most important unit is the Foundation's Awards Selection Committee which does the actual judging of applicants for fellowships, grants and scholarships.

**2. The Instrument Society of America.** Formed in 1946, the Instrument Society of America is a group of approximately 12,000 people organized into nearly 100 local sections throughout the United States and Canada, concerned with the dissemination of information, the stimulation of education activities and the development of standards within the instrumentation technology.

The current membership includes executives and supervisors, engineers and technicians, scientists and educators, purchasing, sales and operating personnel from industrial, commercial, governmental, educational, research and consulting organizations and manufacturers and users of instruments.

In its publications, standards, conferences, symposia, clinics, workshops, courses, training aids, and exhibits, ISA combines a variety of sources for furthering knowledge of instrumentation and for expanding use of modern techniques of measurement, data processing and computation, control and systems engineering.

Through technical as well as industry divisions, through its local sections as well as its national organization, ISA provides a most comprehensive service.

Membership in ISA opens opportunities to you for exchanging instrumentation know-how and for wider recognition of your contribution to the advancement of this technology.

### VI. What is the Opportunity for the Future

The field of instrumentation and control is a lusty infant today but it is growing at a phenomenal rate and offers a fascinating challenge at all levels. Chances are that what we call the "Field of Instrumentation" today will be unrecognizable in 10, 20 or 30 years. Any technology after an unusual growth period usually tends to split into subdivided fields and the embryonic branches of what we call instrumentation today may be major technologies tomorrow.

The power industry for example is due to double its size in the next ten years. This, with advances in high pressure boilers and the use of atomic power, means a tremendous growth in instrumentation in the power industry alone. The distribution of water supply and the transportation of crude oil, gasoline, naphthalene, natural gas, and other similar products, the processing of crude oil from rock shale, the hydrogenation of underground coal deposits, and similar processes largely in an initial development stage at the moment, will require a vast amount of instrumentation and control. The research and development of jet engines and guided missiles will progress far beyond today's horizon, because instrumentation is or will be available for such study.


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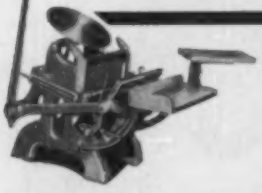
Chandler & Price Printing Presses are designed primarily for commercial use. That is why they have such wide acceptance in school graphic arts departments. With C & P presses, you can teach all of the fundamentals of press operations exactly as they apply to commercial practice. Standardize on C & P presses. You will have equipment for teaching makeready, form make-up, roller and platen adjustment, feeding methods and all basic printing practices.

**C&P NEW MODEL-N**
**Hand-fed Platen Presses, 8x12, 10x15, 12x18**

For practically any school printing department the C & P NEW Model-N hand-fed press is basic equipment. Model-N is fully equipped with no extras to buy. When delivered, it is ready to be put into operation as soon as the electrical connections are made. Completely enclosed, the front panel extends from delivery board to the floor. The drive gear has a new style gear guard; the heavy masonite flywheel guard is bolted to the flywheel. A foot brake is attached to the press and all controls are placed at the front, in full view and convenient command of the operator. Platen guard and floor pan are standard equipment.



**CHANDLER & PRICE PILOT PRESS**

Every school print shop should be equipped with one or more Pilot Presses—ideal for beginner printing instruction. The platen size of 6½" x 10" handles small practice forms with excellent printing results. A small ink fountain may be added as extra equipment.

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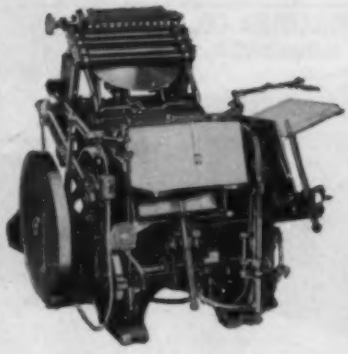
**10x15 12x18**

This side-delivery, automatic press is especially suited to larger vocational schools where more use is necessary and more extensive instruction is practiced. The dual hand-wheel impression control enhances the teaching of proper makeready as required on automatically fed presses. An automatic stop is available as extra equipment, built-in at the factory. When feed and delivery bars are removed, hand-feeding is practicable. While greater in initial cost, the Craftsman Automatic with its exceptional features more than pays off in instruction and production results.



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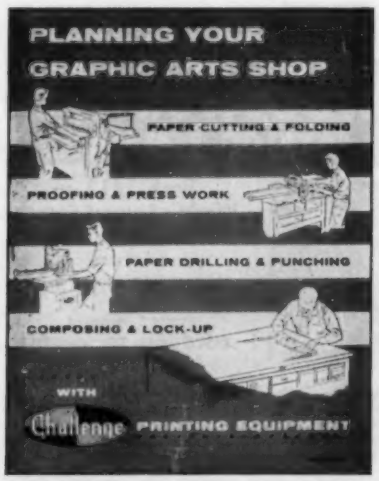


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The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

This wall of steel makes it impossible for the pad to come off the screw during normal use. In fact, our tests have proved that it is virtually impossible to intentionally knock the pad off with a hammer—yet the pad is free to swivel through an arc of approximately 40°.

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**drawing reproduction manual** A second edition of "Drawing for Good Reproduction" has been published by the National Association of Blueprint and Diazotype Coaters. The 32-page treatise shows some minor changes in its basic text, which stresses the importance of good draftsmanship in the preparation of technical drawings and related data and suggests techniques for improving their reproduction. The manual is printed in two colors with many illustrations. Designed primarily for use in mechanical drawing and basic drafting classes, and reproduction departments. Single copies may be obtained at $1 each from the association at 1925 K Street, N.W., Washington 6, D. C.

**chemical aids** An education service of the Manufacturing Chemists' Association, Inc., the "Guide to Education Aids Available from the Chemical Industry" is a 16-page booklet listing a vast array of literature on chemicals, chemical processes, and the chemical industry itself, available to teachers and students free of charge or with a minimum fee. Write the association at 1825 Connecticut Ave., N.W., Washington 9, D. C.

**high fidelity** Electronic Instrument Co., Inc. (EICO) 33-00 Northern Blvd., Long Island City 1, N. Y., offers a "Guide to High Fidelity" at 50 cents a copy. Well-illustrated, the 36-page booklet defines high fidelity, discusses its components, considers principles of harmonics, etc. Also has clearly-written information on stereophonic systems; concludes with hints on cost-cutting with a comprehensive dictionary of terms.

**flooring career** The Armstrong Information Service, Dept. YO, Lancaster, Pa., has available a free, 16-page, colorful booklet, "Your Opportunity as a Professional Flooring Craftsman." Career data on the current need, how to learn, tools, etc.

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# new books

### Teaching the Industrial Arts

By Emanuel E. Ericson. Cloth, 384 pp., 5½ by 8⅝ in., illus., $5.24. Chas. A. Bennett Co., Inc., Peoria, Ill.

With revised sections by Kermit A. Seefeld, this edition has been rewritten extensively in recognition of changes and developments which have taken place since the original volume was presented.

According to the author the activities of industrial arts teachers may be divided into two general classifications — the first consisting of analysis and planning, and the second covering the presentation of teaching material. The author's purpose is to elaborate on the practical points dealing with teaching situations and personal relationships. Patterns of organization, class management, teaching methods, and lesson planning, serve as examples of definite planning and organized procedure. The subject is covered in nineteen chapters; there is an index.

### Teacher Competencies in Trade and Industrial Education

By John P. Walsh. Paper cover, 64 pp., 5⅞ by 9⅛ in., illus., 30 cents. U. S. Department of Health, Education, and Welfare, Washington 25, D. C.

This bulletin suggests one method for evaluating teacher-training programs by providing an inventory of competencies of teachers of trade and industrial subjects as worked out and appraised by leaders in the field. This booklet should aide those in the field of teacher preparation who are engaged in curriculum revision and should also be helpful to supervisors in planning conferences with individual teachers and in developing inservice programs for them.

### Buildings, Equipment, and Facilities for Vocational Agriculture Education

By A. H. Hollenberg and E. J. Johnson. Paper cover, 90 pp., 5¾ by 9⅛ in., illus., 45 cents. U. S. Department of Health, Education and Welfare, Washington 25, D. C.

Prepared for use by school administrators, teachers of vocation agriculture, architects, and state school planning authorities, this booklet is primarily for use when planning new construction. However, schools planning to remodel existing facilities for use by the vocational agriculture department may find the ideas presented of value.

### Orthographic Projection Simplified

By Charles Quinlan, jr. Paper bound, 7¾ by 10¼ in., $1. McKnight & McKnight Publishing Co., Bloomington, Ill.

A new beginning drawing workbook designed to teach the principles of orthographic projection, this book includes some instruction and a number of problems for student work. The illustrations show how views can be projected onto drawing paper from the pictorial drawing. A test follows each unit.

### Forging and Welding Study Guide

By Paul A. Toothman and Robert E. Smith. Paper bound, 144 pp., 7¾ by 10¼ in., $1.80. McKnight & McKnight Publishing Co., Bloomington, Ill.

This workbook is being made available for the first time for the text Forging and Welding. The sheets are perforated for removing and punched to fit a three-hole notebook. They may be used as direct references, as self tests, or as testing devices by the instructor. This guide book is designed to help students remember important details from the tests as they answer the completion, true-false, and matching questions.

# revised wood series

### I. A. Bench Woodwork

By John L. Feirer. Cloth, 208 pp., 6⅞ by 10 in., illus., $3.24. Chas. A. Bennett Co., Inc., Peoria, Ill.

First in a series of three books designed to cover the field of industrial arts education, this book teaches the basic hand skills useful to everyone and how to design, plan, and carry through a project. Safety, consumer values, and conservation are also stressed.

The text is divided into 54 units with questions at the end of each to focus attention on the important ideas and information. It features over 65 project ideas including many detailed drawings and helpful photos. Although the text was designed and written primarily for the early teen ages, it could be used for a first course in woodwork for any age group.

A student guide and workbook keyed to the textbook is also available for 76 cents.

### Industrial Arts Woodworking

By John L. Feirer. Cloth, 320 pp., 6¼ by 9¼ in., illus., $3.96. Chas. A. Bennett Co., Inc., Peoria, Ill.

Second in a series on industrial arts education, the content of this text is organized to meet the needs of students at all levels of junior and senior high school.

Divided into four major parts, the book (1) gives instruction on fundamental processes in hand woodworking, (2) describes the use of fundamental machine tools in woodworking, (3) presents related information about woods, wood products and opportunities in woodworking, and (4) introduces the reader to simple upholstery processes.

A workbook for Industrial Arts Woodworking keyed to the textbook is available for $1.

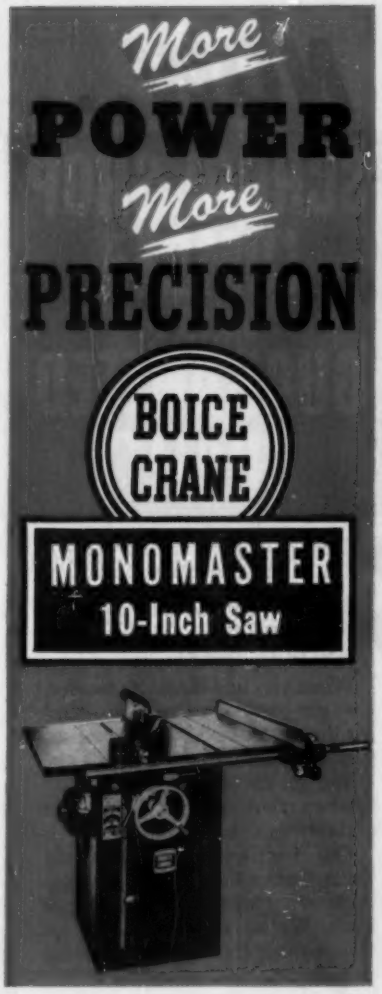
### Advanced Woodwork and Furniture Making

By John L. Feirer. Cloth, 416 pp., 5⅞ by 9 in., illus., $4.16. Chas. A. Bennett Co., Inc., Peoria, Ill.

The most advanced in Feirer's texts on woodworking, this book is written for those interested in making high-quality furniture and who have access to power tools. It assumes the reader has a mastery of hand tools.

It is divided into the following parts: (1) how to select, design, and plan furniture to be built; (2) how to get started in machine woodworking; (3) information covering all special problems in furniture making; (4) how to apply a good finish to furniture and wood; (5) descriptions of all common power tools; (6) a suggested list of furniture pieces including workable ideas and suggested sources; and (7) descriptions of the major furniture styles with a short history of each.

Also available is The Advanced Woodworking Workbook keyed to the text and available for $1.28.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# THE CHALKBOARD AS A TEACHING AID

Of all the aids used by an instructor, the chalk board is undoubtedly the most important. In fact, the chalk board has always been associated as part of a classroom even to the extent of its not being understood by many as an aid.

All the same, its foremost position as an effective aid in teaching is indisputable. An instructor can very well present a subject effectively if he is good at chalk board work and has prepared and planned to use it well. Even if he has other aids, without the chalk board he will find it difficult to teach. More than that the students will find it difficult to understand the important points. It is even said, and rightly too, that the ability of an instructor to make use of the chalk board properly is a true index of teaching effectiveness.

All other aids of which an instructor may make use are prepared outside the class and, as such, the students see only a finished product little knowing how it is arrived at or developed. Therefore, it takes quite some time for the student to understand the details, if at all he understands after fuller explanations. On the other hand if the chalk board is used to develop the subject by easy stages with intermittent explanations, it is bound to make it easier for the learner. Hence, the importance of the chalk board in presenting a clear picture of what the instructor wants the students to understand can be understood.

To get the best out of anything, it is necessary to possess the technique or art which includes, besides the skill and knowledge, the ability to apply them. The chalk board, innocent as it looks, is no exception to this. Chalk board work is a little more than just scribbling something on it with a piece of chalk. It requires preparation, patience, and perseverance. Like every other skill, the ability to use the chalk board properly comes only through purposeful practice.

The size, nature, and position of the chalk board are also points which need attention. Various sizes of chalk boards are available and are in use. The size should be appropriate to the class. About 5 ft. 6 in. by 3 ft. 6 in. would be a useful size for a normal class.

The nature of the board should be such that it facilitates easy writing and easy erasing. It should not be strenuous for the eye to catch what is written. The material used and the type of paint applied also contribute to the nature of the board.

The position of the chalk board in the class should be such that it is convenient both for the instructor and the students. When the instructor stands in front of the class and facing it, the board, if placed on his left would be more convenient. If placed on his right, he will have to cross over every time he wants to use it. It should be at a convenient height too; about 3 ft. 6 in. from the floor would be suitable. The light should be so arranged to prevent any glare on it from any side of the class.

There might be various other types of boards like double sliding boards, vertical or horizontal, continuous rolling boards, portable ones, etc.

While many of the above situations are normally controlled by the administration, the instructor might often help in improving existing conditions for better instruction. However, since these factors also contribute to a certain extent to the technique of effective chalk board presentation, a brief mention has been made here.

### For Effective Presentation

To start with, a clear chalk board is required. A proper wiper intended for the purpose must be used. The practice of using hand or any piece of rag — while it might serve the purpose of erasing — is not considered a good practice nor is it conducive to good technique.

During the planning of the lesson itself, decide what matter is to go on the board and where. If any sketches or diagrams are to be made, carefully practice them.

It would be a good practice either to draw or work with an imaginary vertical line on the board at a distance of about ⅓ the length of the board from the left. On the left hand side of this line the main topics of the lesson should be written in sequence, as it is being presented. The right hand side could be used for developing the topics as needed or for sketching, working out examples, etc. These would be erased after the purpose has been served, while the main topics on the left would remain till the end of the lesson and could be taken advantage of during the summary.

The writing and sketching on the board must be purposeful and clear. It should be large enough for all to see. While writing, the back of the instructor should not be square to the class; in other words, the chalk board should be faced at an angle with frequent glances at the class and brief explanations to them to keep in touch with the class. Colored chalks may be used with definite intention. Indiscriminate and haphazard writing will be a misuse of a good aid. The walking to and from the board should not be abrupt or "jerky," but should be adjusted and timed so that it should be free and easy. Neither the students nor the instructor should have to be forced to the board all too suddenly.

Finally, do not leave the class without cleaning the board. Someone else may have to use the board. Do not leave the board in a condition you would not like to receive it; wipe it clean and also make sure everything is in its place.


— E. G. Menon
senior master, Central Training Institute, Aundh Camp, Poona, India

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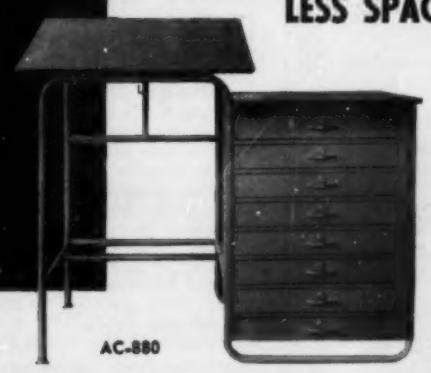

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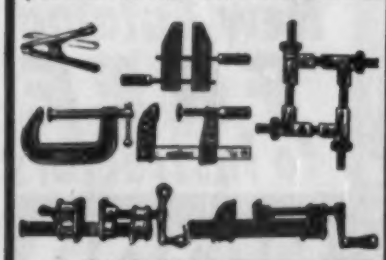

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**(For further details encircle index code 0101)**

**lightweight finishing sander** From The Stanley Works, Sander H37, designed for tireless sanding, particularly flush sanding, with an auxiliary handle removable for close work and a nonslip pistol grip with grooved housing for perfect hand control, ideal for vertical sanding,

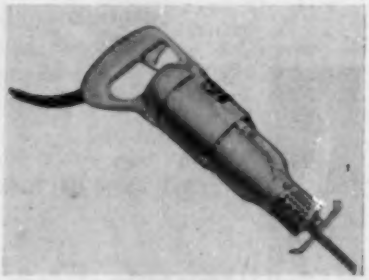
The Stanley Sander H37

equipped with Stanley-built motor, 2.2 amps at 115 volts and maximum ventilation combined for cool, efficient operation. Positive gear drive delivers maximum power to the sanding pad to give more work coverage. Featured also: ball-bearing construction, out-of-the-way cord, and a trigger switch with locking pin which gives complete operation control at all times. Complete with two packages of assorted sanding sheets, it is a fall special.

Another new electric tool introduced for the first time is a new ¼-h.p. general purpose bench grinder for sharpening tools, skates, and removing rust. Special offers available; write for information.

**(For further details encircle index code 0102)**

**sabre saw** From Black & Decker, their heavy-duty Sabre Saw to be shown for the first time in January at the Plant Maintenance Show, at International Amphitheatre, Chicago, Ill. This powerful sabre saw claims three important features: exclusive "rock and lock" shoe, which keeps the shoe flush with the work regardless of



B & D Sabre Saw

angle of cut — or locks the shoe as a firm base to support the tool in scroll cutting; 3-way blade chuck, the blade to be mounted in 3 positions to cut up, down, or sideways; and double-edged B & D-made blade specially designed for making complete accurate pocket cuts in one uninterrupted operation. Other outstanding features include fast cutting through wood, metal, plastics, composition building materials — even pipe; equipped with B & D-built universal motor, spiral bevel gears, special spindle gear for safety and visibility, saw grip handle and instant-release trigger switch, and extra long blade stroke for faster cutting and better blade life. Available in complete kit with 5 blades and all standard equipment in steel carrying box with ample room for extra blades and tools. Ideal for carpenters, electricians, service, and maintenance mechanics. Complete range of 27 sabre-saw blades for general-purpose, high-speed, and special wood and metal cutting are made by Black & Decker for use with the new B & D and other sabre saws. Further information available.

**(For further details encircle index code 0103)**

**self-priming syphon** From General Scientific Equipment Company, an all-polyethelene syphon with a built-in "self-starter." It consists of a semirigid "U" tube with an open end and a flexible "squeeze" bulb attached to the other end. The squeeze bulb has a stopcock outlet. Available in two sizes — one has a ½-in. I.D. tube for use with large drums and carboys and the other has a ¼-in. I.D. tube for use where a slower flow is suitable. To operate, the user first places the open end of the "U" tube in the liquid to be syphoned. The stopcock is then closed. Squeezing the bulb primes the syphon by forcing air out of the open end into the liquid. When bulb

(Continued on page 60)

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These drawings tell the story:




Conventional 7" vise. Note location of spindle and guide bars in relation to jaws.

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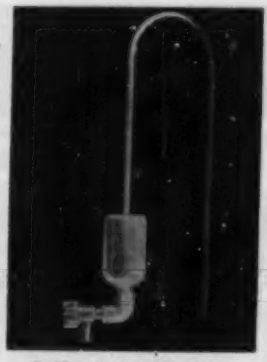
(Continued from page 58)

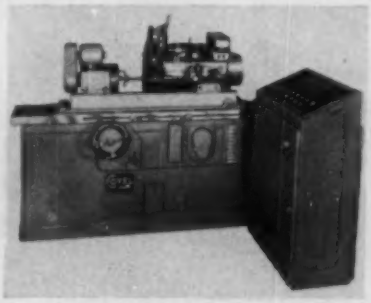


Self-priming Syphon

is released, the partial vacuum created sucks the liquid into the open end, over the "U" bend in the syphon tube, and when the stopcock is opened, into a waiting receptacle. Safe and simple to use, easy to clean, it is resistant at normal temperatures to concentrated acids, oxidizing agents, hydroxides, and polar liquids.

**(For further details encircle index code 0104)**

**cylindrical grinder** From Covel Manufacturing Company, their new No. 42A o.d. electronically controlled grinder with automatic sizing, for production cylindrical grinding on centers a wide variety of parts to close tolerance, its capacity 10-in. diameter by 28 in. long. Full specifi-



No. 42 Cylindrical Grinder

cations available concerning grinding wheel, motors, spindle speed, headstock speed, table traverse, infeed, headstock and tailstock centers, lubrication, standard equipment, automatic cycles, and automatic sizing and operation. Weight of the grinder 7100 lb. net, 8200 lb. crated. Floor space: at right angles to spindle 131 in., parallel to spindle 75 in., maximum height above floor 58 in.

**(For further details encircle index code 0105)**

**offset woodworking vise** From Wilton Manufacturing Company, Inc., an offset vise that is an innovation of a conventional 7-in. woodworking vise whose jaw has been moved 2⅜ in., to the left of the guide bars and spindle. It makes vertical clamping as convenient as in a 10-in. vise and has the same strength and quality at less cost. Available in two models — one having the conventional action nut, and the other the Rapid Titan quick-acting nut; both have jaw sizes of 4 by 7 in., weight 32 lb., aluminum handles. For

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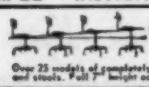

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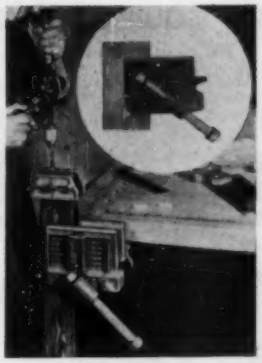
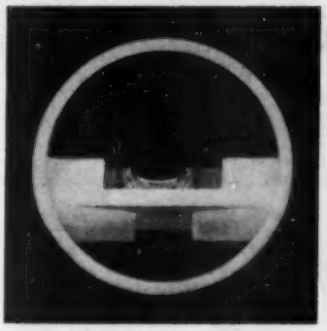


Offset Woodworking Vise

further information on this vise, and other commercial and industrial vises, C clamps, and hydraulic clamping tools manufactured by this company, please write.

**(For further details encircle index code 0106)**

**level vial assembly** From The Columbian Vise & Mfg. Company, a level vial assembly unit consisting of a plastic ring with reinforced vial holder and foundation plus a sturdy, almost invisible plastic band,



Columbian "Compact Vial"

extending full length along both vial sides to guard against shocks, contacts with other tools, etc. A Columbian metallic-sealed vial is inserted securely into the holder ring. This eliminates possibility of tip breakage. The new assembly known as the Columbian "Compact Vial," is so designated because of its exclusive use in the new line of Columbian Compact Levels.

**(For further details encircle index code 0107)**

**lettering instrument** From The Varigraph Company, a tool to produce quality lettering — the Varigraph Lettering Instrument — all parts corrosion-resistant and housed in a molded case secured to a light metal base, weighing 1¼ lb., 7 by 7 by 1⅜ in., with variegated ivory yellow dials, its outside color a variegated emerald green. The letters are formed by moving a stylus along the letters in a grooved templet, while a pen or pencil draws the letter on the work surface. For use in producing hand-lettering and composition for headlines, a new lettering templet has been designed to use with Varigraph Lettering Instruments. While the Varigraph, with standard lettering templets, produces lettering fast and economically, this new templet

(Continued on next page)

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J. W. WELLS DIAMOND HARD

NORTHERN MAPLE

Schools yielding to economy claims of easily dented composition floors for classrooms are more cautious where expensive tools and machinery are involved—a recent survey indicates.*

Except in auto mechanic shops where concrete floors generally predominate most of the shop supervisors report they "prefer" floors like the one shown above in the metalworking shop of the new Evergreen Jr. High School, Everett, Washington (J. W. Wells DIAMOND HARD Northern Maple).

Composition floorings, No. 2 to Hardwood Strip in mechanical drawing shops, appear to have few backers in other shop areas.

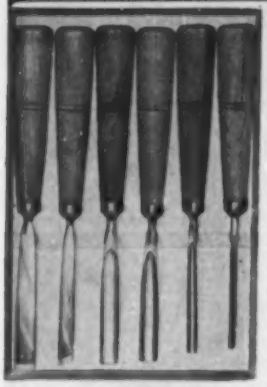
Use These Facts

* For "Facts on Floors in School Shops"—kinds now installed, kinds preferred in each area (Woodworking, Printing, Electricity, etc.) compiled from a survey by Industrial Arts Magazine — WRITE —

J. W. WELLS LUMBER COMPANY

Menominee 11, Michigan

Importers of top quality
CARVING TOOLS



**Set No. 5**

Six tools in serviceable box. Round hardwood handles. Set consists of Chisel No. 101 12 mm. Skew chisel No. 102 8 mm, Gouges No. 104 10 mm, No. 105 10 mm, 3 mm, and V tool No. 106 3 mm wide. Sharpened, need only honing for keen lasting edge. Complete Set, boxed. **$9.50**

**Other Carving Tool Sets from $3.15 (3 tools) to $29.50 (16 tools)**

*Send for Free 12 page folder on wood carving tools and supplies.*

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3577 E. Tremont Ave. ● New York 65, N.Y.

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Here's low-cost protection for students' clothes: Shop aprons in a choice of colors.

Instructors' coats designed for your comfort, long wear. 2 expertly tailored styles, 5colors.

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CAN-PRO Corporation
44 E. McWilliams St. • Fond du Lac, Wis.
Another Subsidiary of J. M. Nash Co., Inc.

## SHOP EQUIPMENT NEWS

(Continued from previous page)

Varigraph Lettering Instrument

will reduce previous costs by an additional 50 per cent. Known as a "fill-in" templet, it not only outlines the formed letters, but fills in the letters as well. It has double-engraved letter grooves, the outer groove engraved deep for outlining the letter with a fine-line pen and a fine stylus, the inside groove engraved shallow for filling in letters with a wide pen and a wide stylus. Hand-filling with pen or brush is no longer necessary. Free literature available; also The Varigraph Company catalog giving complete descriptions of latest type faces and accessories.

**(For further details encircle index code 0108)**

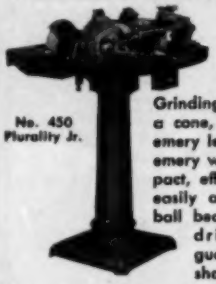
**work table** From Boice-Crane Company, the fourth work table of a line for their 18- and 24-in., geared head drill presses, which is completely interchangeable with the other tables without machining and incorporates the same unique rotating feature. Over-all size is 25 by 20 in., outside a deep coolant trough completely surrounding the 22¼ by 17¼-in. finished work surface. Heavy ribbing spans the entire underside of the working surface. Ask for the new brochure describing the work table.

Drill Press Work Table

**(For further details encircle index code 0109)**

**drawing table** From The Garrett Tubular Products, Inc., the new Model 520 drawing table for schools, with the board storage space moved to the front of the table, offering storage for six drawing boards. Six drawers are keyed differently and master-keyed. Two plastic taborets and new adjustment for raising and lowering drawing board which is 24 by 24 in. Larger drawing boards are available. Less space

**TOOLS ALWAYS SHARP WITH PLURALITY OILSTONE TOOL GRINDERS**



No. 450 Plurality Jr.

NOW AVAILABLE IN 3 SIZES
No. 425 Plurality Sub Jr.
No. 450 Plurality Jr.
No. 475 Plurality

Grinding can be done on a cone, coarse or fine or emery leather stropping or emery wheels. Unit is compact, efficient, serviceable, easily accessible and has ball bearing direct motor drive. Especially guarded for school shop use. Details on request.

**MUMMERT-DIXON CO.**
HANOVER, PENNSYLVANIA
*Originators and Pioneer Manufacturers of Oilstone Tool Grinders*

**WOODSHOP INSTRUCTORS**
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the magnetic Jointer and Planer knife-setter that is rapidly outmoding and replacing the old, mechanically inaccurate, time-consuming straight-edge method! The necessity of tapping, prying and re-adjusting is entirely eliminated! Thousands now in use! Write for complete information and name of your nearest distributor.

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3. Four-Station Workbenches with tools for elementary schools and a novel saw bench.
4. Four-station drafting and planning table with storage for all drafting equipment.
5. Wall-tool Cabinets and Bench-Tool Cabinets.
6. Metal Working Bench, sheet-metal Benches and Stake-plate Bench with concealed storage for stakes and machines.
7. Anvil Base with storage for anvil tools.
8. DeLuxe Drafting Table with complete equipment storage including T-squares and boards.

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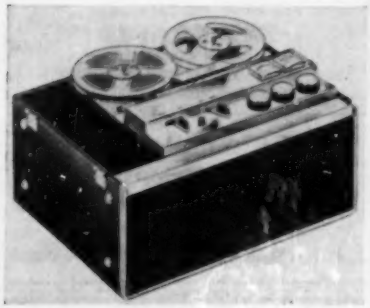
**STONER WOOD PRODUCTS CO.**
CHARLESTON, ILLINOIS

Model 520 Drawing Table

is needed for this table which allows more tables in smaller classrooms. New catalog available on request.

**(For further details encircle index code 0110)**

**3-speed stereo tape deck** From Allied Radio Corporation, a versatile tape-recording deck — the Knight KN-4075 3-speed Stereo Tape Deck — employing four separate preamps, two for recording and

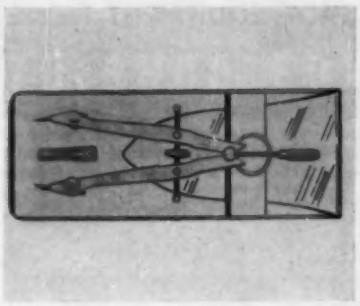


The Knight KN-4075 Stereo Tape Deck

two for playback, and three heads for erase, record/play, and monitor functions. It plays back through stereo hi-fi systems or stereo headphones, and features switch-selected equalization for any of the three speeds — 1⅞, 3¾, 7½ in., per second. Also two illuminated VU meters, calibrated with VU scales as well as 0–100 per cent scales, an equalized phono input for magnetic stereo phono cartridges; a premium-quality laminated record/play head providing high output with low eddy current losses; a monitor head for sound-on-sound recording besides its regular function. Other features: digital tape footage counter for easy editing; fast drop-in tape threading; record interlock to prevent accidental erasure; high-speed fast forward and fast rewind controls, lock-in type; guaranteed high-fidelity specifications; and carrying case. Stock No. 35 DU 713.

**(For further details encircle index code 0111)**

**bow compass** From Alvin & Co., a lightly designed 6-in. Bow Compass combining quality with economy. Styled of anodized aluminum for lighter weight and proper balance, it incorporates a steel center assembly for durability with nickel spindle caps and supporting steel parts, also a rapid center wheel adjustment for circles ranging from ⅛- to 9-in. diameters. A plastic tube holds the divider needle and shoulder needle points in addition to compass lead and spare parts. Entire compass

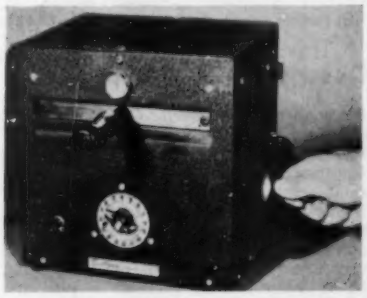


Bow Compass

enclosed in protective vinyl case for easy handling. Write for further information.

**(For further details encircle index code 0112)**

**rubber stamp press** From King Machine & Manufacturing Company, the new Berkroy press for making rubber stamps quickly and easily, with a built-in timer, heat indicator, and thermostatic control. This compact unit is 8 by 9 by

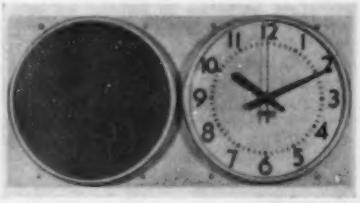


Berkroy Rubber Stamp Press

10 in. high, weighs 75 lb., and operates on 110-volt a.c. current. The case is all steel with heavy-duty steel-frame construction with a heat-resistant black crackle finish. Also available is a supply kit with sufficient materials for making 200 rubber stamps.

**(For further details encircle index code 0113)**

**electric clock and speaker combinations** From The Standard Electric Time Company, a line of units combining a clock and speaker companion-mounted in a common panel, furnished with either round or square dial compo-



Clock-Speaker Combination Unit

nents, for installation in schools, hospitals, factories, and other institutional and industrial buildings. The clock-speaker combinations are engineered for integration with all types of centrally controlled time, program signal, music, or communication systems. Complete information available from the manufacturer.

**(For further details encircle index code 0114)**

(Continued on next page)

PLEASE SEND ME McKNIGHT'S NEW FREE SHOP BOOK CATALOG WITH COMPLETE LISTING OF SHOP, CRAFT, PROJECTS AND METHODS "TELL HOW" "SHOW HOW" BOOK.

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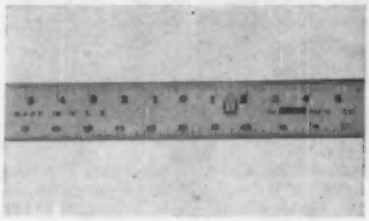
1132 Orchard St. Racine, Wis.

## SHOP EQUIPMENT NEWS

(Continued from previous page)

**measuring rule** From The Fairgate Rule Company, an innovation in measuring — the C-24 measuring rule made of hard aluminum with straight edge — which splits distances exactly in half, in a fraction



The C-24 Measuring Rule

of a second. Instead of the conventional way of measuring with numbers running from left to right or right to left, C-24 begins in the center of the rule and measures outward in two directions. Additional literature available.

**(For further details encircle index code 0115)**

### Descriptive Material . . .

*From Brodhead-Garrett Company,* their six-page handy school catalog of the Pickett all-American, all-metal slide rules, featuring a number of remarkable innovations — for the use of students and professionals. This descriptive folder shows the complete line of Pickett slide rules and teaching aids, all models being available in exclusive "5600" Pickett Eye-Saver yellow, or in white. Folder includes a slide-rule selector guide.

**(For further details encircle index code 0116)**

### from the field . . .

**Magnaflux Corporation,** Chicago, a wholly owned subsidiary of General Mills, has acquired Metal Control Laboratories, Los Angeles, to effect a complete complement of integrated nondestructive, metallurgical, and physical testing facilities and skills. The acquisition was a cash transaction.

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Complete stock of lamp parts for your lamp projects shown in our catalog. Also contains charts and instructions for building and wiring lamps. These valuable instructions and catalog sent for 25¢.
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## INDEX TO SHOP EQUIPMENT

**The index and digest of advertisements below are provided for your convenience in requesting free product information, catalogs and literature offered by the advertisers and the manufacturers listed in Shop Equipment News. To obtain this information or literature, encircle code numbers, sign the card, and mail. Your request will receive prompt attention.**

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| 12 | **American Technical Society**<br>Textbook Publishers. Free Catalog | 61 |
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| 14 | **Atlas Press Company, The**<br>Floor saw | 2nd cover |
| 15 | **Bedford Lumber Co.**<br>Cedar, veneer chests & red cedar lumber | 62 |
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**These cards are provided for the convenience of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION readers in requesting information on products, services, booklets, and catalogs offered by the advertisers in this issue.**

**INDUSTRIAL ARTS AND VOCATIONAL EDUCATION** January, 1961
**400 North Broadway, Milwaukee 1, Wisconsin**

Please ask the manufacturers, whose code numbers I have encircled, to send me the information, catalogs, or product literature offered in this issue.

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NEWS OF PRODUCTS FOR THE SCHOOLS

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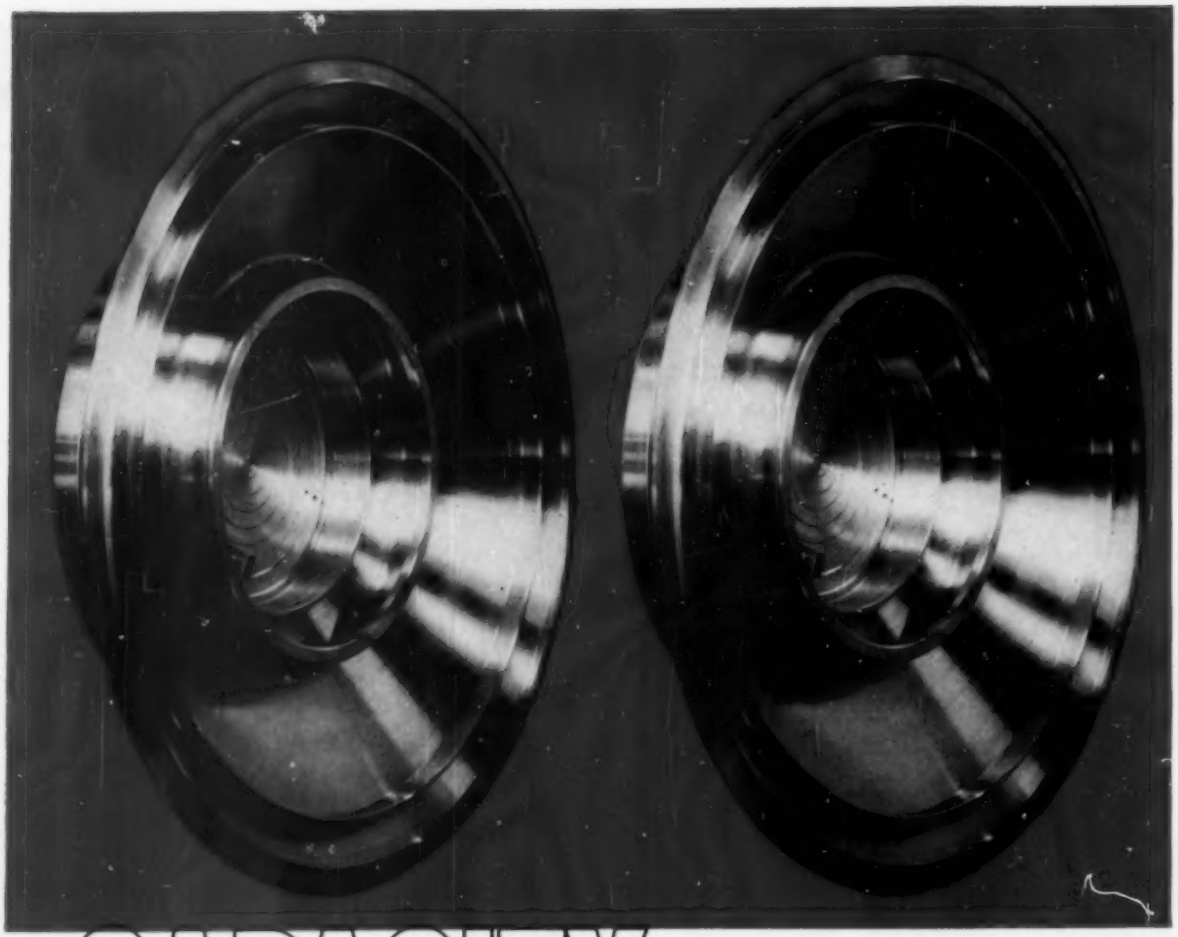

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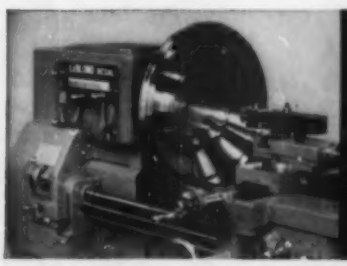

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